• NOVEMBER 1952 •

100 Years of Engineering 867

Stronger Engineering Graduates . . . . . *G. E. Doan* 877

Modern High-Pressure High-Temperature Boilers—2 . . . . . *G. W. Kessler* 878

Bearings, Lubricants, and Lubrication—A Digest of 1951 Literature 885

Manpower Utilization and National Security . . *C. H. Brown* 892

The ASME Boiler Code IV—ASME Expands the Boiler Code—1919-1924 . . . . . *A. M. Greene, Jr.* 897

Departments

Briefing the Record, 909
ASME Technical Digest, 919
ASME News, 935
Buyer's Catalog Guide, Adv. Page 43

ASME ANNUAL MEETING—New York, N. Y., November 30-December 5, 1952

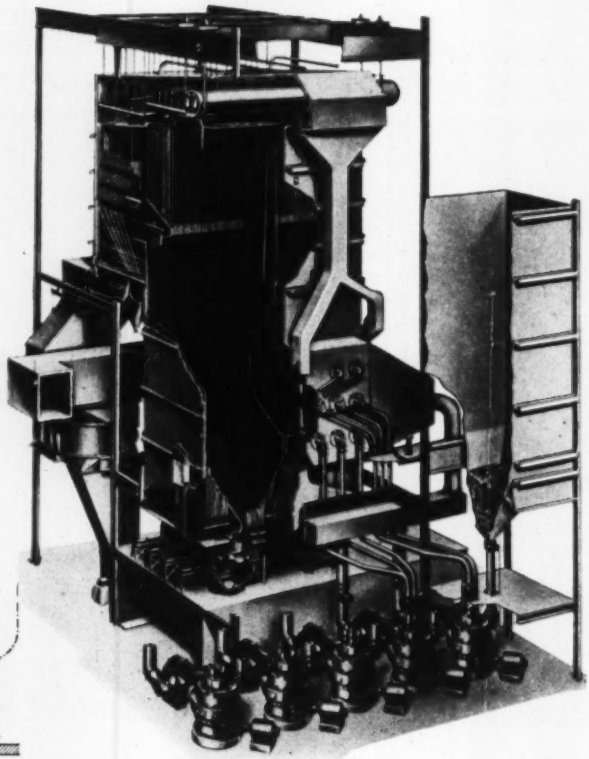
Engineering . . .

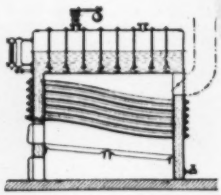
MAN'S ANSWER *to* NATURE'S CHALLENGE

Nature's challenge to Man to take bounty of the Earth and transform it into usable material established, in fact, the profession of Engineering. Since Man's first awareness of Fire, one of the most important jobs confronting engineers has been to constantly improve upon ways to release, harness and control fuel-energy stored in the Earth to produce power and heat for human benefit.

For nearly a century, The Babcock & Wilcox Company has worked with other engineers in contributing to better utilization of fuels for producing steam to generate electric and industrial power, and for industrial processing and heating.

Long a most economical medium for harnessing usable energy, steam continues to challenge the ingenuity of engineers. Fuel and combustion engineers, stress analysts, fabricating men, structural engineers, chemists, physicists, heat transfer experts, ceramic engineers and metallurgists all contribute importantly to the art of converting Nature's energy resources to Man's practical use through the design of modern steam generating equipment.





1856—First steam boiler design patented by Stephen Wilcox, Jr., co-founder of The Babcock & Wilcox Company.

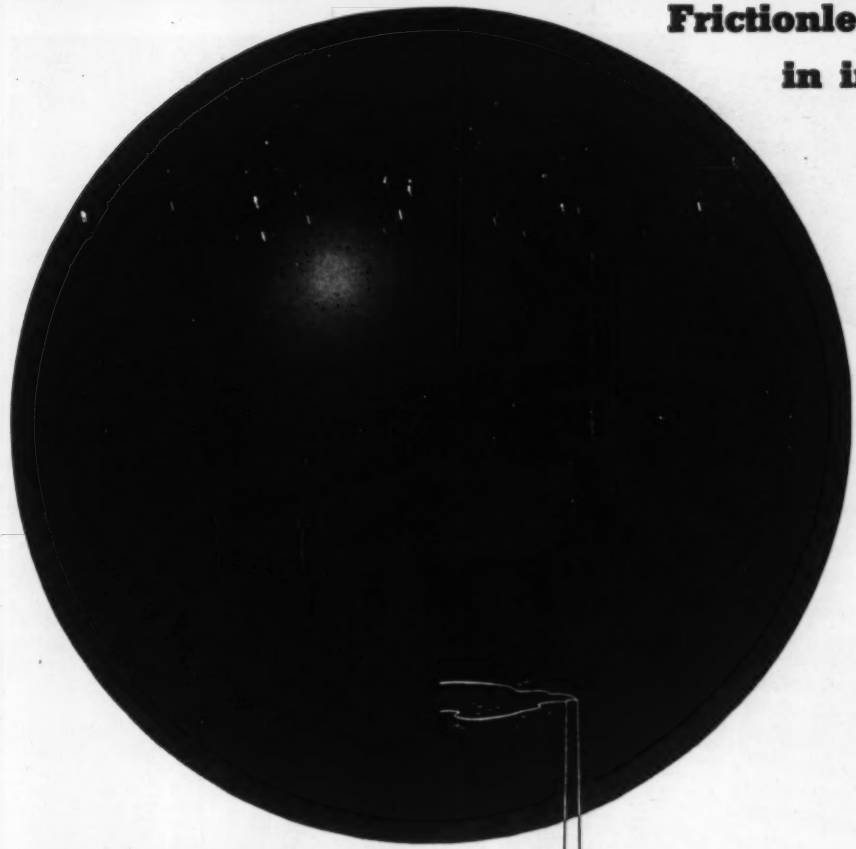
1952—This typical modern B&W central station boiler with a steam capacity of 1,350,000 pounds per hour generates many times as much energy per pound of coal as boilers of nearly a century ago. Its enormous size is indicated by man in circle.

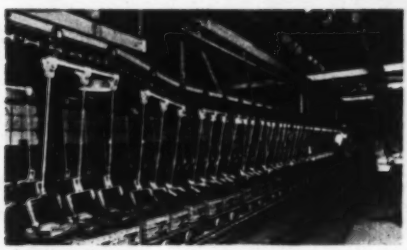
B&W

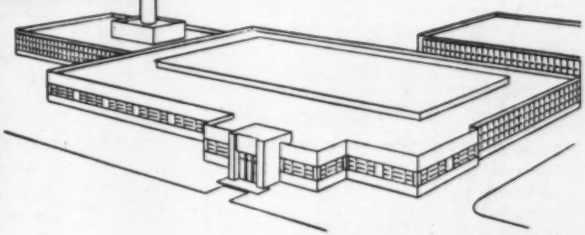
BABCOCK & WILCOX

G-577

Frictionless Flow in industry







The "Sealed-for-Life" ball bearings originated by New Departure play a real role when materials are conveyed mechanically. Overhead or underground . . . carrying sand or steel . . . moving coal or castings . . . conveyor systems equipped with N-D Ball Bearings reduce handling costs.

With grease sealed in and dirt sealed out, these bearings resist loads of all kinds for years without adjustment. It is not unusual to find installations that were made twelve to fifteen years ago still in efficient, effective operation.

The Great Ball of New Departure symbolizes engineering excellence—and New Departure's application engineers and research facilities are always at your disposal. Keep your eye on the BALL to be sure of your BEARINGS!

NOTHING ROLLS LIKE A BALL

NEW DEPARTURE
BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

MECHANICAL ENGINEERING, November, 1952, Vol. 74, No. 11. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50¢; to nonmembers one year $7.00, single copy 75¢. Postage to Canada, 75¢ additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3,1879. Member of the Audit Bureau of Circulations.

M. W. KELLOGG

American Gas & Electric Service Corp.
Boston Edison Co.
Central Hudson Gas & Electric Co.
Compania Argentina De Electricidad
(Argentina)
Compania De Fuerza [illegible]
De Mexico

PICTURES TELL THIS IMPORTANT STORY BEST!

. . . final turbine lead for 1000 F — 1850 psi installation goes in. See why Kellogg handles many of the most important hi-temperature, hi-pressure systems.

Line-up . . . perfect alinement micrometer tolerances of sections weighing tons.

Check-up . . . engineers verify the proper spacing in weld grooves and fit of backing rings.

Temperature Control . . . accurately positioned thermocouples control temperature under all conditions.

The Preheat . . . induction heating at optimum temperature assures crack-free weld.

First Bead . . . senior engineer supervised . . . complete fusion, uniform backing ring penetration are "musts."

No Letdown . . . zing-free surfaces, uniform weld-metal deposits, constant temperatures on each successive layer.

Finished? . . . welding completed, yes . . . but then comes radiographing and vital multiple heat stress relieving.

engineers have better thought. It's a fact that all of the meticulous work done in the pre-fabrication of critical alloy piping sub-assemblies can be undone through improper field assembly and welding.

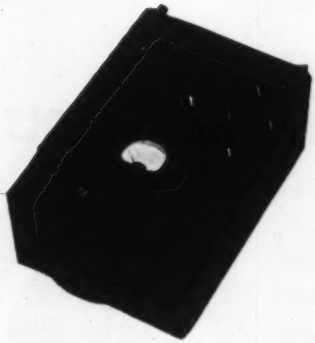
now evaluates its position. Adhering over the years to the principle of close integration of basic research, engineering fabrication and construction—Kellogg believes there is no better demonstration of its value than the demand for Kellogg pre-fabrication and installation of critical electric utility piping.

OTHER FABRICATED PRODUCTS including:
Pressure Vessels . . . Vacuum Vessels . . . Fractionating Columns . . . Drums and Shells . . . Heat Exchangers . . . Process Piping . . . Bends and Headers . . . Forged and Welded Fittings . . . Radial Brick and Concrete Chimneys.

for 51 years an integral part of industrial progress!

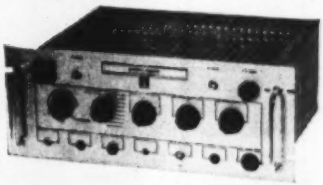
Fabricated Products Division—The M. W. Kellogg Company SUBSIDIARY OF PULLMAN INCORPORATED

New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris.



AMPLIFIES LOW VOLTAGES

Analysis of static or dynamic conditions involving either high or very low forces is simplified with this Brush Direct-coupled Amplifier. Used with the Brush Magnetic Oscillograph, any need for complicated intermediate equipment is eliminated. The direct-coupled Amplifier has high sensitivity and low drift . . . zero signal drift not more than one chart millimeter per hour.



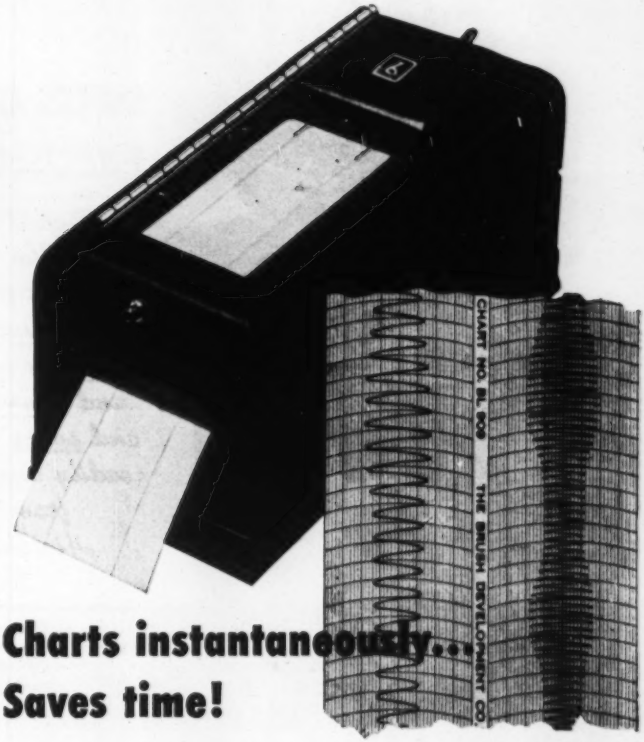
RACK-MOUNTED STRAIN ANALYZER

This new Brush Strain Amplifier, functionally similar to the standard table top model, is designed for mounting in a standard 19-inch rack. When used with the Brush Direct-Writing Oscillograph, the equipment records either static or dynamic strains with direction and magnitude shown on the chart. Operation is simple, records are immediately available and easily interpreted.

SHOWS SURFACE PROFILE

The Brush Surface Analyzer® shows average roughness in micro-inches, and also provides a chart of surface irregularities. The chart shows a highly magnified profile of the surface, on which variations of less than 1 micro-inch are readily apparent. Eliminates guesswork in specifying and checking finishes.

For complete information write The Brush Development Co., Dept. P-42, 3405 Perkins Ave., Cleveland 14, Ohio



Charts instantaneously... Saves time!

● You eliminate laborious testing and plotting of data when you use Brush Recording Analyzers. Static or dynamic phenomena, electrical or mechanical in nature, can be recorded instantaneously with high accuracy.

This two-channel Brush Magnetic Oscillograph, used with the proper Brush Amplifier, makes a direct dual-chart recording of voltages, currents, or physical phenomena such as strains, pressures, accelerations, torques, forces, displacements, or vibrations. Either direct inking or electric stylus models are available.

Flexibility is a major advantage with the Brush Oscillograph. Chart speeds of 5, 25, or 125 mm. per second can be selected readily. An auxiliary chart drive for slower speeds is available. Other accessory equipment provides event markings for an accurate time base, or for correlation of events.

Apply time-saving Brush instruments to your testing problems . . . in the laboratory, on the test floor, or in the field. You'll get expert technical assistance from Brush representatives located throughout the U. S. In Canada: A. C. Wickman, Limited, Toronto.

For catalog write The Brush Development Company, Dept. P-42, 3405 Perkins Ave., Cleveland 14, Ohio

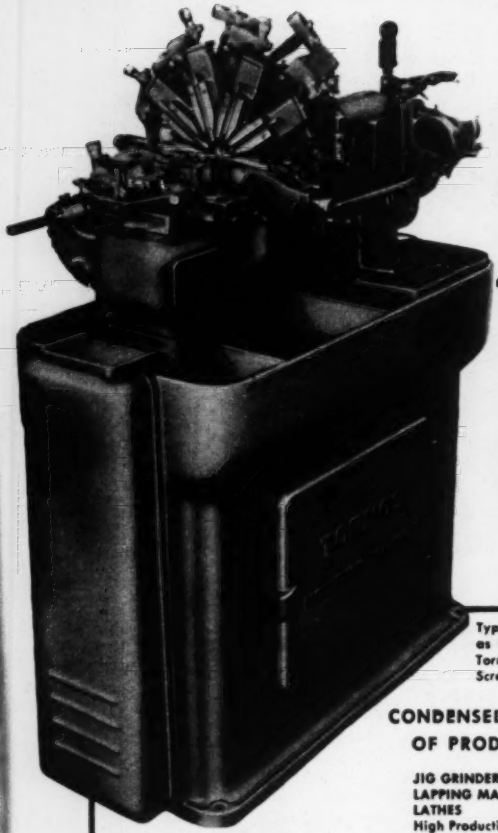
PUT IT IN WRITING WITH A BRUSH RECORDING ANALYZER

THE Brush DEVELOPMENT COMPANY

BRUSH

Piezoelectric Crystals and Ceramics
Magnetic Recording Equipment
Acoustic Devices
Ultrasonics
Industrial & Research Instruments

SWISS BLUE RIBBON PRECISION MACHINE TOOLS



Backed right here in the U.S. by skilled technicians, factory service and guarantee, and spare parts readily available from every Hirschmann Branch.

Typical as to precision and as to fame of trade name. Tornos R10 Swiss Automatic Screw Machine.

CONDENSED SUMMARY OF PRODUCTS

BAND SAW & FILING MACHINES
CAM-MAKING EQUIPMENT
CHECKING & MEASURING INSTRUMENTS
Horizontal Micrometers • Optical
Vertical Micrometers
CHUCKS
Keyless Drill
DIAMOND & OTHER ABRASIVE WHEELS
DIE SETS
DIE SINKERS
DRILLING & TAPPING MACHINES
FINISHING MACHINES
Precision
FORMING & CUTTING-OFF MACHINES
Automatic
GEAR HOBBING MACHINES
GRINDERS
Tool • Twist Drill
GRINDING MACHINES
Hydraulic • Hydraulic Cylindrical
Jig • Optical • Universal
INDEX HEADS
Universal
JIG BORERS
JIG GRINDERS
LAPPING MACHINES
LATHES
High Production • Rapid Copying
Toolmakers' • Turret & Repitition
MILLING MACHINES
Cam • Production • Surface • Toolmakers'
PANTOGRAPHS
POLISHING MACHINES
PRESSES
Automatic for Bolt & Nut Industry
Bench • Cam • Die • Heavy Duty
Hot & Cold • Shaving
SCREW MACHINES
Swiss Automatic
SHAPER
Short Stroke • Copying
SPECIAL AUTOMATICS
For Watchmaking and similar industries
THREAD CHASING MACHINES
Semi-Automatic
THREAD CUTTING MACHINES
Automatic
THREAD ROLLING MACHINES
Automatic
TOOLS
Screw Machine-Carbide and High Speed Steel
TURNING MACHINES
Semi-Automatic

BLUE RIBBON List of Trade Names

Agathon
Bartsch
Burri
Chappuis
Diametal
Dubied
Ebosa
Esco
Essa
Hauser
Hommel
Huller
Kellenberger
Kummer
Lambert
Lienhard
Manurhin
Meteor
Mipsa
Nassovia
Safag
Schaublin
Technica
Thommen
Tornos
Tripet

Exclusively Represented in the United States by Carl Hirschmann Co. 30 Park Ave., Manhasset, N.Y.

HIRSCHMANN

MANHASSET · CHICAGO · CLEVELAND · DETROIT · LOS ANGELES · MILWAUKEE

Representatives in Principal Cities

How to INCREASE BOILER RATINGS with your present furnace and stack

Coppus-Dennis FANMIX Burners Give You More Heat with No Other Major Change in Equipment

Coppus-Dennis **FANMIX** Burners give you *perfect* mechanical mixing of fuel and air *at the burner outlet . . . instantaneous* ignition close to the burner . . . and *complete* combustion *without visible flame* when burning natural gas. No other burner combines these three advantages.

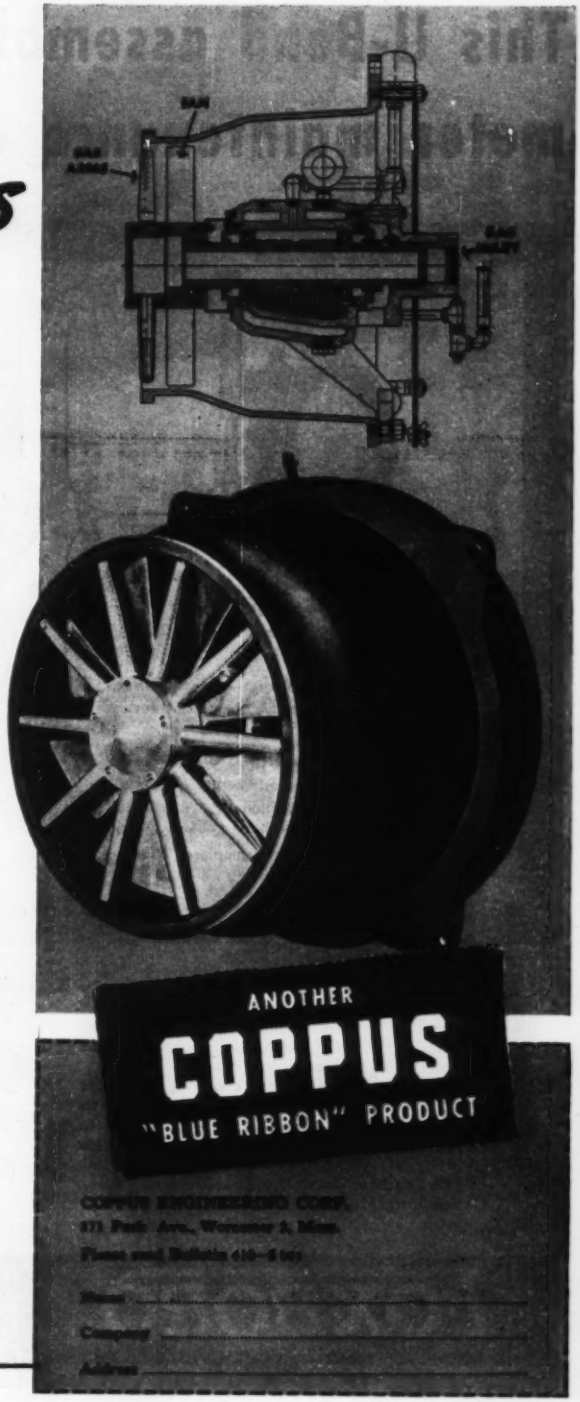
Because **FANMIX** delivers the *right* mixture of fuel and air *without blow-torch action*, all of your furnace space is used for combustion . . . *none for mixing*. That's why your present furnace can release more heat . . . why new installations can get more heat out of smaller furnace space.

Because **FANMIX** can be guaranteed to secure complete combustion of natural gas *with less than 5% excess air*, you get uniform "radiant heat" *without drifting hot spots*. That's why a **FANMIX**-fired furnace seldom varies in temperature more than 5% over its entire area.

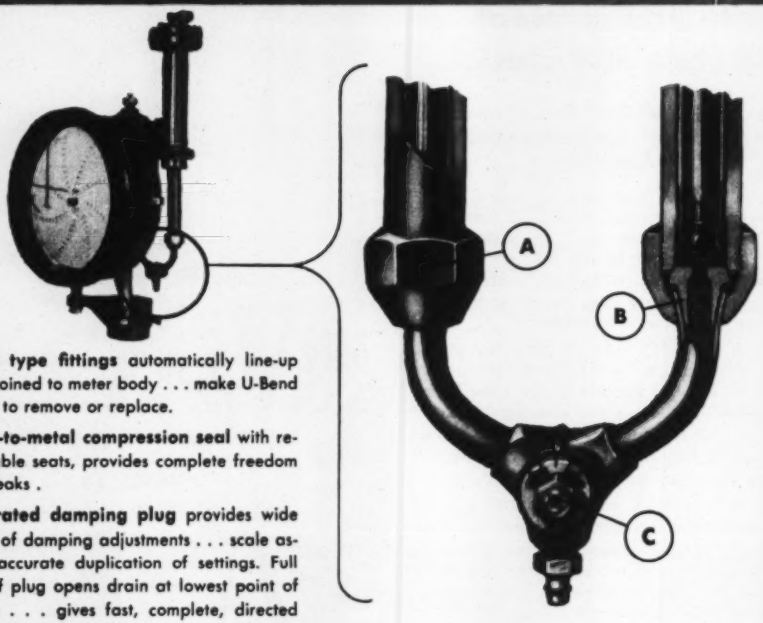
WRITE FOR ALL THE FACTS

When you see in Bulletin 410–6 how fuel escaping from orifices in rotating driver arms rotates the fan to draw the correct proportion of air into the path of the fuel at right angles . . . how **FANMIX** creates its own forced draft, reduces stack requirements, prevents cracking of "wet" gas . . . how two **FANMIX** types handle either gas or oil or any combination of both — you'll understand why **FANMIX** Burners have such wide acceptance in oil refineries and power plants.

Send for the Coppus-Dennis **FANMIX** Bulletin 410–6. Coppus Engineering Corporation, Worcester 2, Mass. Sales Offices in **THOMAS' REGISTER**. Other Coppus "Blue Ribbon" products in **BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG,** and **REFINERY CATALOG.**



This U-Bend assembly makes meter maintenance easy as A, B, C!



A **Union type fittings** automatically line-up when joined to meter body . . . make U-Bend simple to remove or replace.

B **Metal-to-metal compression seal** with replaceable seats, provides complete freedom from leaks .

C **Calibrated damping plug** provides wide range of damping adjustments . . . scale assures accurate duplication of settings. Full turn of plug opens drain at lowest point of system . . . gives fast, complete, directed drainage.

Here's a union-coupled U-Bend Assembly engineered to preserve meter accuracy and simplify routine maintenance and adjustment. It is one of the many basic advances you get in Foxboro Flow Meters.

Before you place your next flow meter order, compare *all* the advanced features in the new Foxboro line. They total up to much longer, far better service per dollar invested. Write for detailed Bulletin 460. **The Foxboro Company, 9611 Neponset Ave., Foxboro, Mass., U.S.A.**

OTHER NEW BASIC ADVANCES

- **Precision Float Assembly** with stainless steel ball chain and collet-type clamp insures slip-proof, friction-free transmission of float motion to the recording pen.
- **Pressure-Seal Bearing** — stainless steel, with exclusive O-Ring seals . . . friction-free and leak-proof at all working pressures. No lubrication required.
- **Sure-Seal Check Floats** insure perfect seating . . . no loss of mercury on overrange in either direction. Floats submerged in mercury keep clean and trouble-free.

FOXBORO REG. U.S. PAT. OFF. **... First in FLOW METERS**

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

Established 1888

D.O.James

CENTRALLY DRIVEN BALANCED DRIVE
With Great Emergency Strength

GEAR SPEED REDUCERS

GEAR SPEED REDUCER

MOTORIZED REDUCER

MOTOR REDUCER
A Packaged Unit

Multiple tooth engagement, low tooth stresses, with high load capacity and high wear factor. Gears are heat treated, shafted and crowned (Elliptoid), equally balanced and revolving in same direction, quiet operation, long gear life, and highest efficiency.

Catalogs are available containing complete engineering data.

D.O.JAMES GEAR MANUFACTURING CO.

1140 WEST MONROE STREET • CHICAGO 7, ILLINOIS

SKF

BALL AND ROLLER BEARINGS

No designer today has to be sold on the advantages of anti-friction bearings. However they *used* to pose one serious problem to machine designers — that of the difficulty of mounting and removing interference fits, especially in bearings of comparatively large size. *Not so today.*

In the System of Hydraulic Removal, developed by SKF, OIL does the work. With simple equipment, you force oil between the shaft and the bearing, pressure breaks the fit, and the bearing slides off quickly, easily, safe from damage to bearing or housing. The same system eliminates the need for driving the tapered bore bearing *on* the shaft, or heating to obtain a shrink fit.

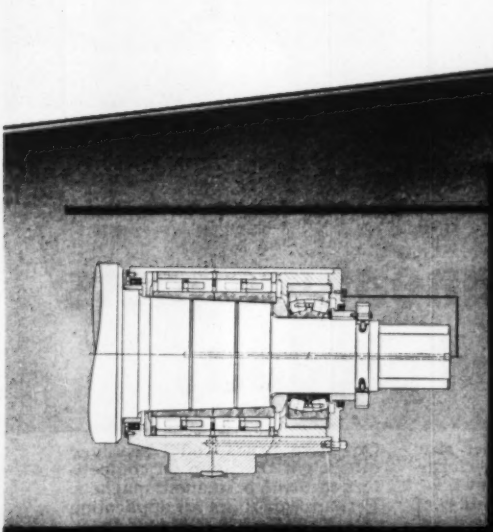
The accompanying illustrations show a few of the successful applications of this SKF principle —on roll neck bearings in steel mills, printing cylinder and paper mill roll bearings, on SKF "OK" Shaft Couplings, main and crank pin bearings in air compressors. The principle is also well suited to other equipment such as crushers, construction machinery, etc.

SKF's first patent application on the hydraulic mounting principle was made in 1943.

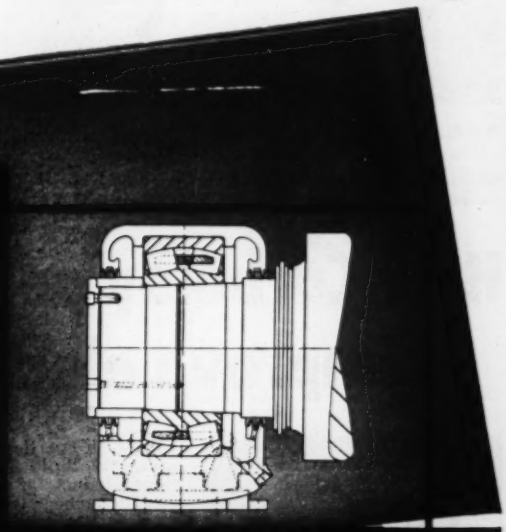
Since then, more and more equipment designers are taking advantage of this SKF "first." For further details, write for SKF Brochure No. 344.

SKF INDUSTRIES, INC., PHILADELPHIA 32, PA. *— manufacturers of* **SKF** *and* HESS-BRIGHT *bearings.*

7361



Typical Application Of SKF Hydraulic Mounting For Roll Neck Bearing.

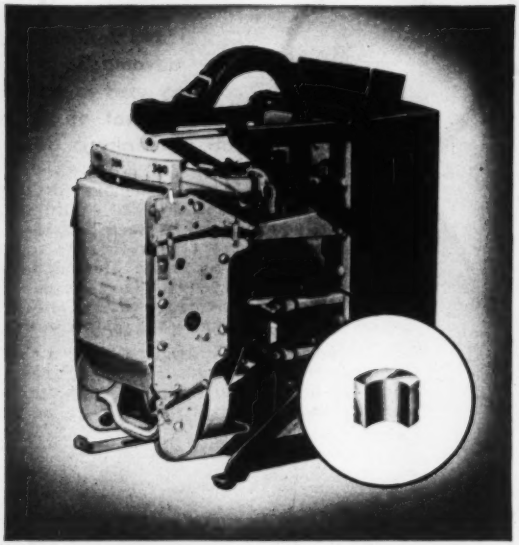


Typical Application Of SKF Hydraulic Mounting For Printing Cylinder And Paper Machine Roll Bearing.

"OK" Coupling On 7⅜" Marine Shaft, Depends On Pressure Only To Transmit Torque. Separable By SKF Hydraulic System.

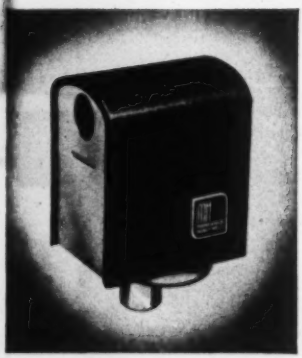
SKF Roller Main And Crank Pin Bearings With Hydraulic Mounting Feature On A Pneumatic Compressor.

INSTRUMENTS—Fig. A is damping magnet once used in GE indicators. Fig. B is tiny Carboloy magnet now used. It permits smaller indicator design (Fig. C), cuts materials and assembling costs . . . speeds up calibrations.



METERS—In this portable current recorder a Carboloy permanent magnet cuts costs by eliminating power-supplying parts. It also reduces recorder's weight by 10 pounds.

How Carboloy permanent magnets improve electrical products



CONTROLS—Switches in compact Minneapolis-Honeywell controls use permanent magnets to give safer snap action, help quench arcs. The magnets are exceptionally stable; provide uniform high energy for the life of the control.

Want to cut down product size, weight? Build a better-performing product for less money?

Then check the possibility of using Carboloy Alnico permanent magnets wherever you need *lasting* magnetic energy.

Carboloy permanent magnets are simple, self-containing sources of energy that *never* fail. They are powerful in small sizes. Need no outside power supply, no maintenance. They help reduce fabrication costs by eliminating wires, coils and operating parts. Above all, they let you simplify design . . . build a lighter, more compact, finer-performing product at a saving.

On these pages you'll see how others got the jump on competitors by using permanent magnets. Perhaps you'll get an application idea from reading about them.

CARBOLOY SERVICES

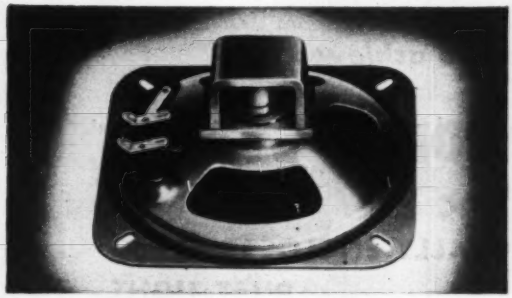
If so, check Carboloy magnet engineers for free, expert advice and an assist in design and application. Look to Carboloy production lines, too, for the uniform, high-energy Alnico magnets you'll need for best results — all sizes, all shapes; cast or sintered to your specifications.

Send coupon for free Magnet Design Manual PM-101 and Standard Stock Catalog PM-100.

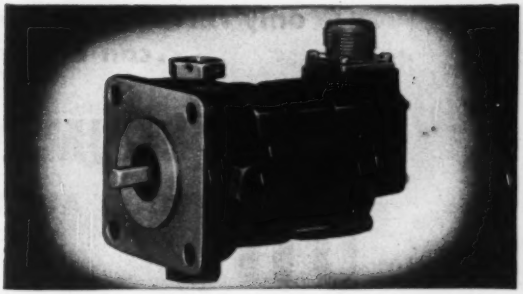
CARBOLOY

DEPARTMENT OF GENERAL ELECTRIC COMPANY

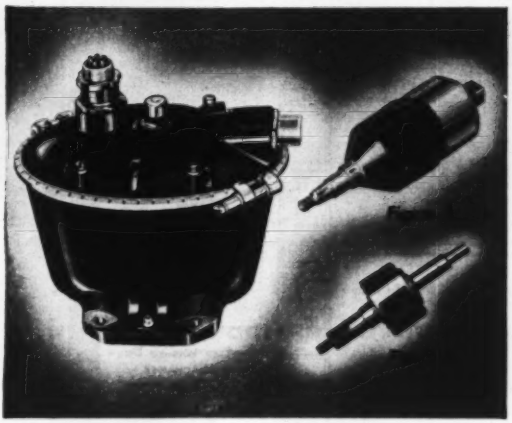
11199 East 8 Mile Road, Dept. B, Detroit 32, Michigan



SPEAKERS—In speakers, permanent magnets replace larger electromagnets in field structure. Current passing through Alnico's *uniform* field makes voice coil and cone vibrate in proportion to voltage; tone is truer.



GENERATORS—When GE engineers had only 6" x 6" area for jet's tachometer generator, they whipped design problem with a tiny permanent magnet. It eliminated coils and wires, supplied the powerful energy required.



MAGNETOS—To Scintilla Magneto Division, Bendix Aviation Corp., weight savings are vital in their aircraft products. Fig. A shows chrome rotor weighing approximately 4 lbs. 9 ozs. Fig. B shows newer model rotor using Carboloy Alnico. It weighs only 2 lbs. 4 ozs.

ADVANTAGES OF CARBOLOY PERMANENT MAGNETS

1. Simple — no operating parts
2. Uniformly powerful
3. Permanent source of energy
4. No coils to wire
5. Cool-running
6. No operating costs
7. No power failures
8. Combine electrical and mechanical features
9. Simplify mechanical assemblies
10. Uninterrupted operation
11. Moisture-resistant
12. Create savings

"Carboloy" is the trademark for the products of Carboloy Department of General Electric Company

Plants at Detroit, Michigan; Edmore, Michigan; and Schenectady, New York

CARBOLOY ALNICO PERMANENT MAGNETS

Mail Coupon Today

Carboloy Department of General Electric Company
11199 East 8 Mile Road, Dept. B, Detroit 32, Michigan

Gentlemen:

Please rush me, without cost or obligation, copies of Permanent Magnet Design Manual PM-101 and Standard Stock Catalog PM-100.

NAME _____

POSITION _____

COMPANY NAME _____

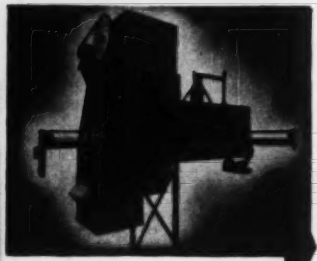
ADDRESS _____

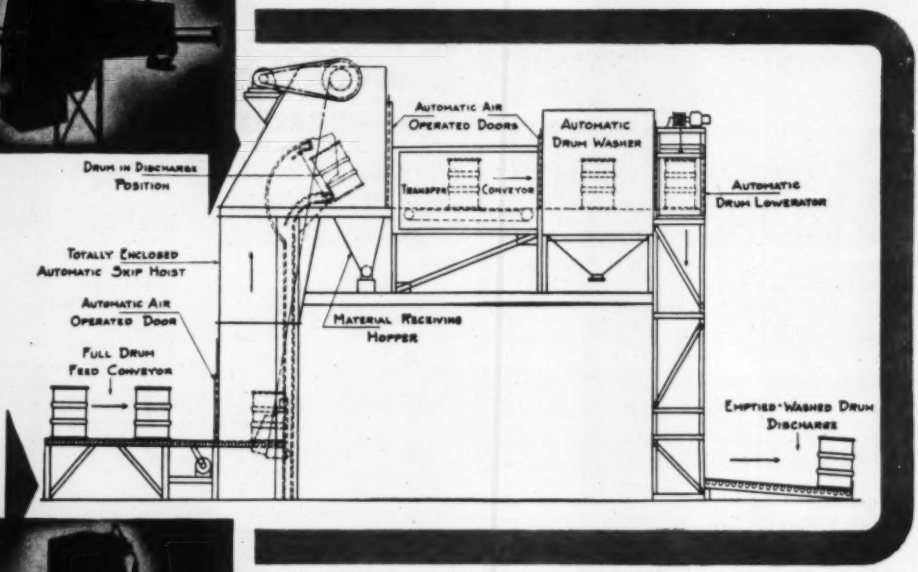
CITY _____ ZONE _____ STATE _____

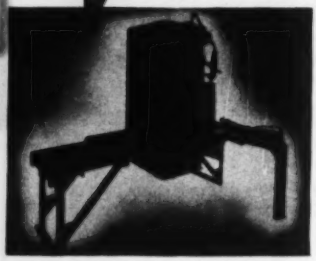
only through Engineering...
...can efficiency be achieved

G-W DRUM HANDLING SYSTEM

FULLY AUTOMATIC
TOTALLY ENCLOSED
DUST TIGHT







Faced with an ever-increasing bottleneck in drum handling, a large eastern manufacturer placed his problem in the hands of Gifford-Wood's Materials-Handling Engineers. The result was the fully automatic system shown in the drawing. This dust-tight, fully enclosed installation now handles drums at the rate of 30 to 40 drums per hour.

The cover of the full drum is removed at a point on the feed conveyor. The full drum is then elevated and inverted, pouring the contents over a vibrating grate into the receiving hopper. Carried on a transfer conveyor to the automatic washer, the drum is cleaned, then lowered to the discharge conveyor.

This is just one of many examples of how G-W materials handling know-how achieved efficiency through engineering — efficiency in this case reflected in automatic handling at a greatly increased rate, with elimination of waste and maximum safety — all at greatly reduced cost.

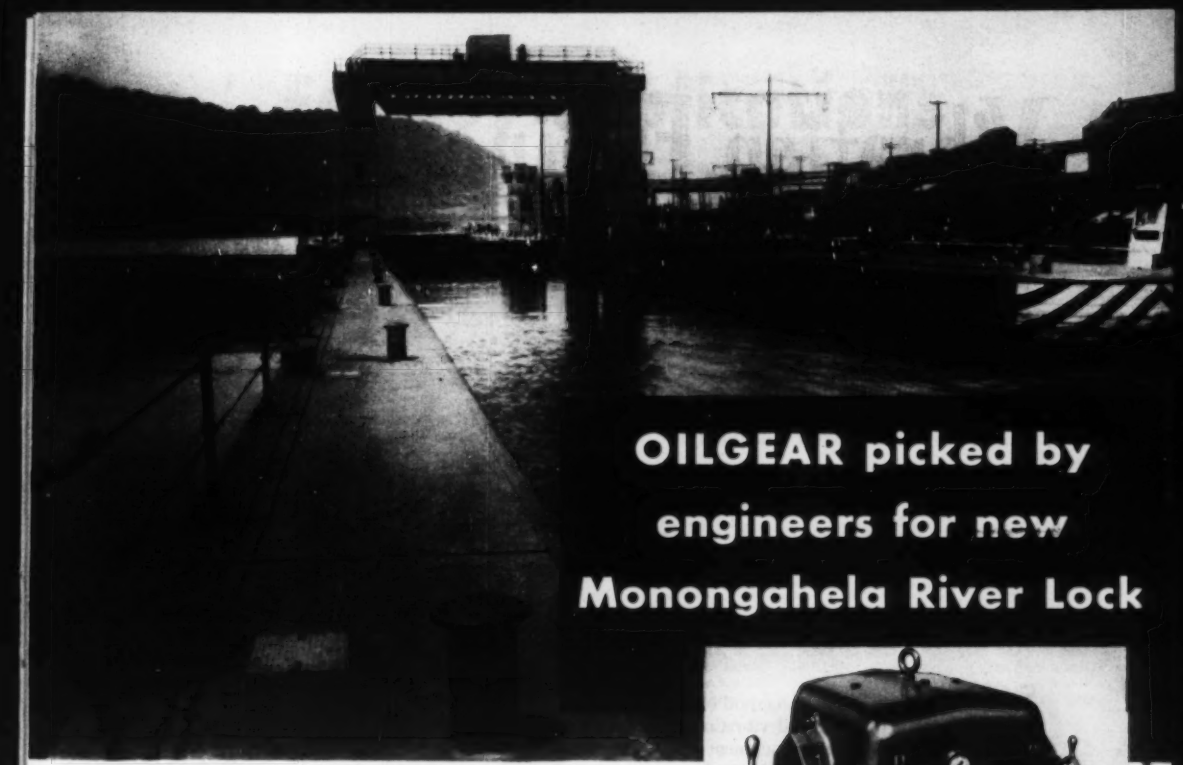
Call upon G-W Materials-Handling Engineers to survey your present methods; you are under no obligation. It might well prove to be a step toward higher profits through lower operating and maintenance costs.

When You Think of Materials Handling—Think of **GIFFORD-WOOD CO.**

Since 1814 • Hudson, New York

NEW YORK 17, N. Y. 420 LEXINGTON AVE. | ST. LOUIS 1, MO. RAILWAY EXCHANGE BLDG. | CHICAGO 6, ILL. 565 W. WASHINGTON ST.

⊕ 8404



OILGEAR picked by engineers for new Monongahela River Lock

Photo courtesy Corps of Engineers, US Army

This versatile fluid power also used in McNary Dam and Bayou Boeuf Locks

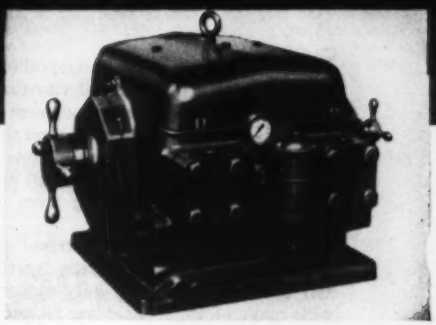
The problem of selecting the power to operate the lock gates, butterfly valves and capstans in the new Monongahela River Lock was to provide the speed of operation, the capacity and the dependability that would keep the rapidly growing volume of shipping on the move. The river at this point now handles millions of tons more annually than Panama.

Certainly, in the fact that Oilgear Fluid Power equipment was selected for this lock, as well as for those at McNary Dam in Oregon, and at Bayou Boeuf in Louisiana, is evidence of the repute in which Oilgear is held.

But we are inclined to stress the *versatility* of Oilgear Fluid Power . . . its applicability to a wide range of needs ranging from the impressive capacity required for lock operation . . . to the delicate and assured precision, controllability and accuracy required in printing on flimsy cellophane . . . and to the middle ground of industry where production must always be increased and always kept on the move.

Fundamentally there is no difference. There must be power, *ample* power, susceptible of control some times rushing and gigantic, some times a mere whisper of power whittled down to a point, as it were.

With Oilgear Fluid Power available in pump and cylinder for straight line motion, or in pump and motor or integrated transmission for rotary motion or reduction of ratio, you have a power source and method applicable to any need. In addition, you gain ability to vary speed or power steplessly in an extremely broad ratio. You can have power that does not move but simply holds a member under constant pressure. You can have speed that clings closely to the changing viscosity of a beaten mass... or power that forms giant airplane fuselages and wings.



Oilgear Two-way Variable Delivery Pump with Electro-hydraulic Three-position Remote Control.

Whatever your problem, it deserves the opportunity to be matched with Oilgear versatility for a better solution. It will cost you nothing to investigate. It may show you a tremendous gain. THE OILGEAR COMPANY, 1570 W. Pierce St., Milwaukee 4, Wisconsin.

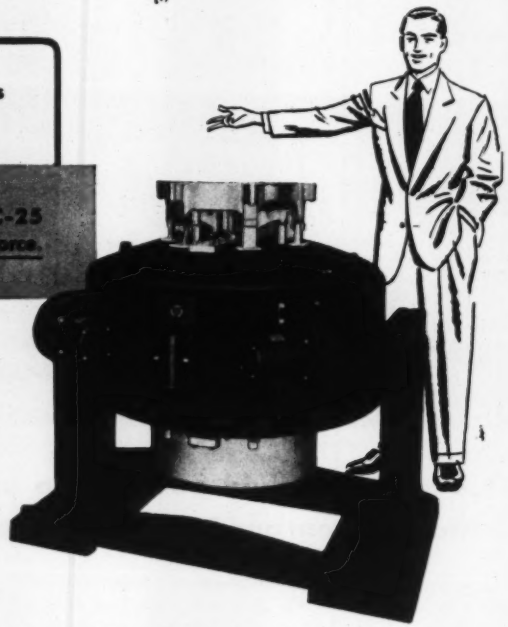
OILGEAR

OILGEAR

Vibration Engineering that solves your problems

PROBLEM: To perform vibration tests to MIL-E-5272 and other specifications.

SOLUTION: The MB Model C-25 Vibration Exciter rated at 2500 lbs. force.

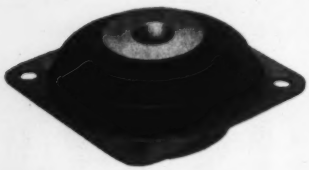


Shake testing gives a quick method of developing a product to withstand vibration. Such testing is vital for military equipment—and a good idea for any product. To meet this need, MB has applied its specialized vibration engineering to develop a range of shakers in various ratings for testing everything from electron tubes to airframes.

The big C-25 model illustrated develops large "brute forces" to satisfy specification MIL-E-5272. It has heavy duty capacity for a wide range of work, including fatigue testing. It features accurate, continuous control of force and frequency. Its control panel is available with an automatic cycling system for specific cycling tests called for in the MIL-E-5272 specification.

One of the largest and most dependable electromagnetic shakers available, the C-25 model is a good example of the quality of vibration engineering that has made MB "headquarters" for products to isolate, control, reproduce, detect, or measure vibration. More information on MB Vibration Exciters in Bulletin 1-VE-4. Write us.

Want a standard mount for vibration isolation in the special class?



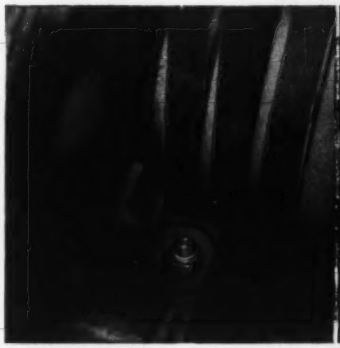
With the Isomode* Type 17 Isolator, you not only conform to MIL-I-5432 specification but also get an unusual degree of isolation efficiency. It has equal spring rates in every direction. This means better control of all modes of motion. For details on this mount, write to Dept. 4.

Trade Mark Reg. U.S. Pat. Off.

THE MB MANUFACTURING COMPANY, INC.
1060 STATE STREET, NEW HAVEN 11, CONN.

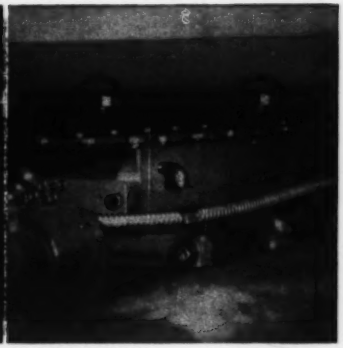
PRODUCTS AND EQUIPMENT TO CONTROL VIBRATION • TO MEASURE IT • TO REPRODUCE IT

For key applications on heavy-duty equipment



ENGINE MOUNTING . . . Powerful, high torque FWD engines are securely and dependably anchored with vibration-proof Elastic Stop Nuts. The Red Elastic Collar grips bolt threads firmly, withstanding the stress and shock of the most severe operating conditions . . . damping out even the most extreme vibration.

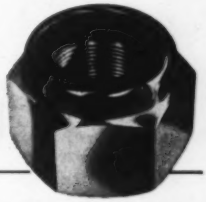
TRANSMISSION SEAL . . . Proper lubrication of heavy-duty working parts demands a tight seal, here assured by the application of Elastic Stop Nuts on this FWD transmission. The famous Red Elastic Collar seals against oil seepage.



CAB MOUNTING . . . With the rugged jobs that FWD trucks tackle, their powerful frames are subjected to severe stresses. Only a tough and tested self-locking device could be expected to remain tight—that's why FWD uses Elastic Stop Nuts on cab mounting bolts.

FWD TRUCKS

Four Wheel Drive uses *Elastic Stop* nuts



Uninterrupted service and minimum maintenance are vital to the customers of the Four Wheel Drive Auto Co., makers of special heavy-duty trucks. FWD is particularly conscious of the importance of unfailing bolted connections. They are using Elastic Stop Nuts at key points throughout their line, simplifying their own assembly as well as assuring better performance for their customers.

Resilient locking collars of nylon or fiber permit multiple reuse of Elastic Stop Nuts, and these self-locking fasteners have earned Army, Navy and Air Force approval. For design information on the wide variety of sizes, types and applications of Elastic Stop Nuts, contact your local representative—or mail this handy coupon.

ESNA

Elastic Stop Nut Corporation of America is also maker of ROLLPIN

ROLLPIN TRADEMARK

Dept. N7-1111, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, N. J.

Please send me the following free information on ESNA self-locking fasteners:

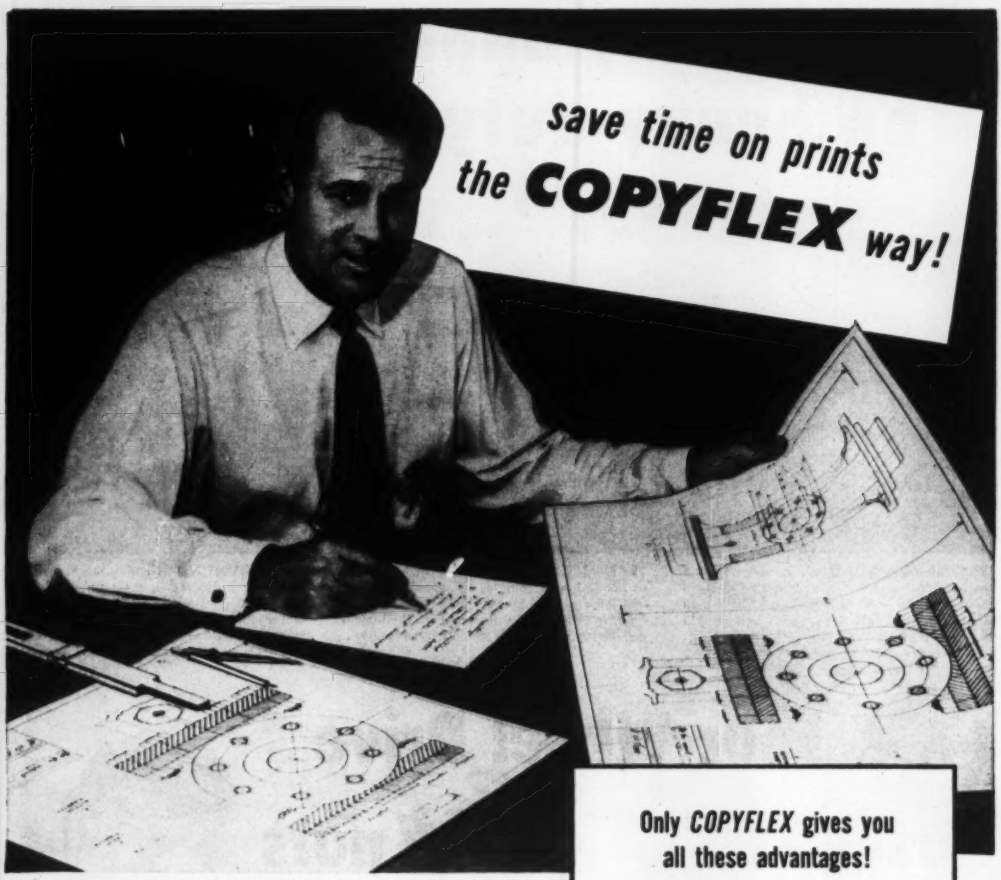
- ☐ AN-ESNA conversion chart
- ☐ Elastic Stop Nut Bulletin
- ☐ Rollpin bulletin and sample Rollpins
- ☐ Here is a drawing of our product. What self-locking fastener would you suggest?

Name _____ Title _____

Firm _____

Street _____

City _____ Zone _____ State _____



You'll get prints *on time* despite today's greater demands if Bruning COPYFLEX machines replace or supplement inadequate whiteprinters.

The COPYFLEX process gives you fast service on prints . . . as many as you need.

And what prints you get from a COPYFLEX machine! They're clean, sharp, accurate reproductions delivered flat and ready-to-use. What's more, only with COPYFLEX can you make prints on so many different kinds of materials. For Bruning makes the widest range of sensitized papers, cloths and films. Get the full facts on COPYFLEX . . . mail the coupon!

Only *COPYFLEX* gives you all these advantages!

- **No fumes or exhausts because it uses no vapor developer**
- **Top-quality prints ready for immediate use**
- **No installation—simply make an electrical connection**
- **Wider range of sensitized and coated papers, cloths and films**
- **Anyone can operate a COPYFLEX machine with a simple 5-minute explanation**

COPYFLEX "93" is virtually automatic, handles cut sheets or roll stock up to 42 in. wide.

BRUNING

Specialists in copying since 1897

CHARLES BRUNING CO., INC.

Dept. H-112 125 North St. Teterboro, N. J.

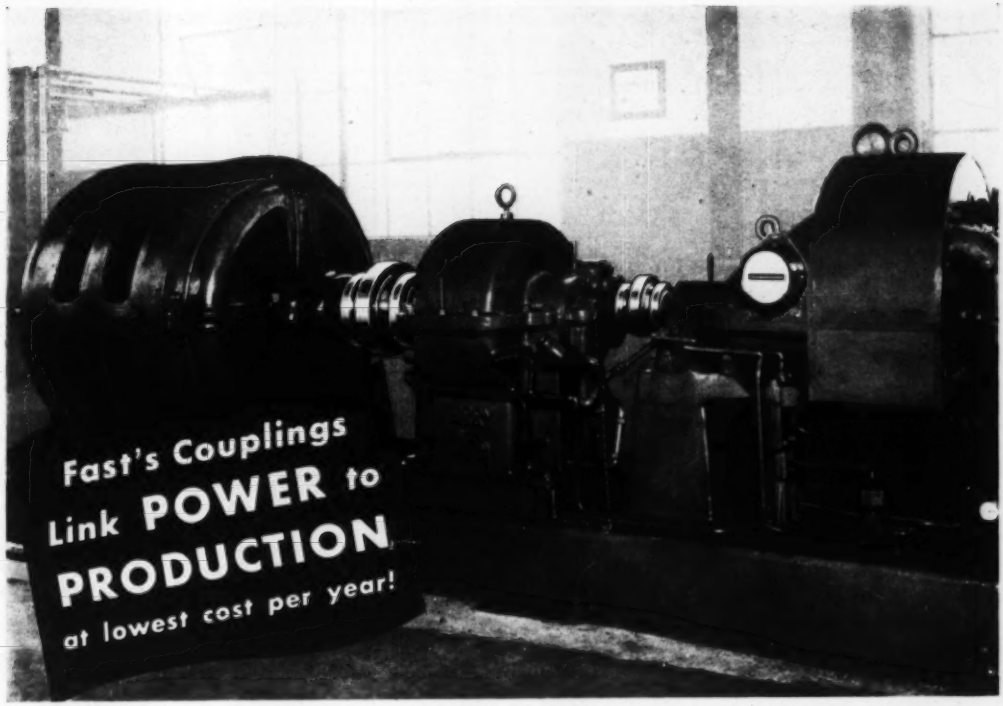
☐ Send me free booklet on COPYFLEX process and equipment.
☐ Show me COPYFLEX in action (no obligation).

Name.....Title.....

Company.....

Street.....

City.....Zone.....State.....



Every major producer of high-speed equipment uses FAST'S Couplings!

HIGH-SPEED equipment demands components with superior strength, accurate manufacture, long-lasting dependability. That's why it's important to *you* that Fast's Couplings are selected by every major high-speed equipment producer!

Fast's usually outlast the equipment they connect. Many have been in continuous operation for over 30 years, without trouble of any kind. And Fast's longer life saves you coupling dollars, too, because you amortize their cost over many years of trouble-free operation.

For full details on Fast's Couplings and Koppers Engineering Service, write today for your free copy of our catalog. Send to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 351 Scott St., Baltimore 3, Maryland.

KOPPERS

FAST'S
THE ORIGINAL GEAR-TYPE
Couplings

INDUSTRY'S STANDARD FOR 32 YEARS

Here's How FAST'S Save You Money

Free Service—Koppers free engineering service assures you the right coupling for the job.

Rugged Construction—Fast's still maintains its original design, without basic change or sacrifice in size or materials. Result: freedom from expensive coupling failures.

Lowest Cost per Year—Fast's Couplings usually outlast equipment they connect. Their cost may be spread over many years!

KOPPERS COMPANY, INC., ***Fast's Coupling Dept.***
351 Scott St., Baltimore 3, Md.

Gentlemen: Send me Fast's Catalog which gives detailed descriptions, engineering drawings, capacity tables and photographs.

Name _____

Company _____

Address _____

City _____ *Zone* _____ *State* _____

6 reasons why

It's the Experience that Counts . . .

RELIANCE V★S
is the result of nearly 50 years' experience in the engineering and application of Adjustable-speed Drives.

Write today for important *NEW* data on Reliance V★S Drive (3/4 to 300 hp.) and how it can give you greater flexibility of operation to increase production and lower costs. Ask for V★S Drive Bulletin D-2311.

RELIANCE V★S *is important to you*

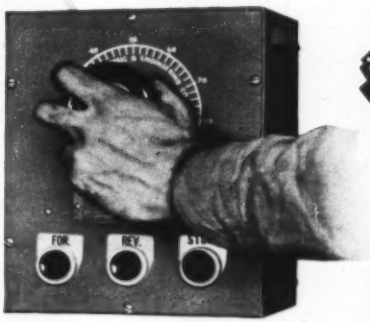
quick starting — without use of clutches; smooth action protects fragile materials.

quick, smooth stopping of any load through positive electrical braking which never wears out or needs adjustment.

controlled acceleration and deceleration—your operator can increase or decrease speed at any desired rate; provides for best machine performance.

unlimited speed changes over a wide range permit selection of the right speed for machine, material and operator to secure maximum production.

inching, jogging or creeping through adjustable slow speeds; your operator can slow down a machine for inspection, then accelerate quickly and *exactly* to previous working speed.



convenient-to-operate controls grouped and located where your operator can quickly, easily and safely control all functions of his machine. Operator fatigue is reduced—there is less production lag over the course of a shift—scrap losses are held to a minimum.

Sales Offices in Principal Cities

RELIANCE ELECTRIC AND ENGINEERING CO.

1062 Ivanhoe Road, Cleveland 10, Ohio • Canadian Division: Welland, Ontario

Job Proved HYDRAULIC POWER to 5000 psi

Denison High-Pressure Axial Piston PUMPS

Denison High Pressure Axial Piston Pumps have received unqualified approval on countless high pressure applications—industrial, oil, field construction, marine, automatic, and ordnance.

Their powerful, compact construction features hydraulic balance throughout . . . elimination of thrust bearings . . . improved shaft construction that absorbs deflection and compensates for external shaft loads or coupling misalignment. Space-saving design, with a choice of face, flange and foot mountings, simplifies installation. The advantages of Denison hydraulic pumps can be *proved by comparison* on your job. Write for full information.

GET MORE POWER FOR YOUR MONEY

- Constant or Variable Volume
- Stem, Cylinder, Handwheel or Compensator Control
- Volume Capacities to 35 gpm
- Rugged, Axial Piston Design
- Hydraulically Balanced Throughout

SEND FOR BULLETINS ON DENISON PUMPS AND CONTROLS TO FIT YOUR NEEDS

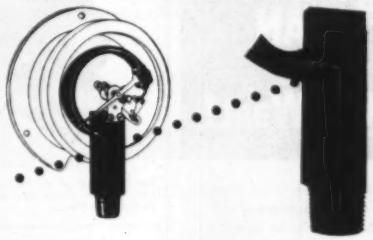
The DENISON Engineering Co.
1189 Dublin Road, Columbus 16, Ohio

DENISON HydrOILics

Have you investigated the new Denison Vane-Type Pump/Motor?

MARSH *Introduces—*

the most significant pressure gauge development since the "Recalibrator"



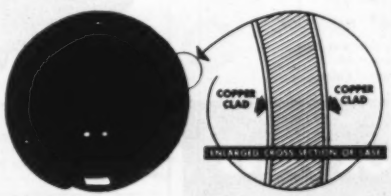
Socket, tube, and end-piece fused into one-piece unit —The problem in every pressure gauge has always been to make permanently leak-tight joints from the inlet to the tip of the bourdon tube.

Marsh construction has always provided the utmost in leak-tight assemblies. But just as welded piping is always more sound than the best joined piping, the fusing of the assembly into an integral unit reduces the possibility of leakage to the vanishing point.

It required extensive research to develop a method of welding the parts into a one-piece unit, but a special process has now been perfected. The result is known as

the "Canowold" Tube

After fusing, the tube is accurately tempered to required resiliency. The unretouched photo of a socket sawed in half shows the perfect fusion of the joint most difficult to make — the joint where the tube enters the socket. Photomicrographs are available to prove the perfection of the process.



Four times as strong and one-third lighter than a cast iron case — This copper-clad, wrought steel case of boiler plate thickness has the advantages of any type of case — without the faults. It is known as

the "Marshalloy" Case

This case is four times as strong and one-third lighter than conventional cast iron cases. The copper surface makes it as non-corrosive as a plastic or die-cast case. It is finished in a newly developed corrosion-resistant satin black enamel that makes it as attractive as it is durable. Fitted with Marsh safety blow-out plug, it sets a new standard in gauge housing.

THE Marsh developments presented here unquestionably represent the two greatest contributions to pressure gauge accuracy and stamina in recent years . . . the most important advancements since the introduction of the Marsh "Recalibrator."

These improvements take on all the more significance from the fact that they are contributed to the line of gauges that has become the symbol of gauge accuracy and permanence . . . the Marsh "Mastergauge" line.

Foremost and most basic of these improvements is the fusing of the socket, tube, and end-piece into the equivalent of *one-piece* construction. Marsh Methods have always achieved the utmost in leak-tight construction, but here is something still better: the joints are *eliminated!*

Second only to the one-piece socket, tube, and end-piece is that new "Marshalloy" copper-clad case. It is a case that retains all advantages of all kinds of cases; eliminates all the faults.

Read the facts opposite and you will see how the finest line of pressure gauges has been made still better.

MARSH INSTRUMENT CO.

Sales Affiliate of Jos. P. Marsh Corp.

Dept. 29, Skokie, Ill.

Houston Branch Plant
1121 Rothwell St.
Houston, Texas

MARSH GAUGES

"THE STANDARD OF ACCURACY"

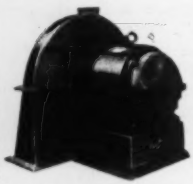
THERMOMETERS • WATER REGULATING VALVES
SOLENOID VALVES • HEATING SPECIALTIES

LIMIT-LOAD FANS

For large-scale ventilation. Quiet, non-overloading. Sizes up to 500,000 c.f.m. Bulletin 3737.

TYPE "CB" PRESSURE BLOWERS

For single-stage pressure blowing up to 2¼ pounds, per square inch. Bulletin 3553-A.



TYPE "CC" PRESSURE BLOWERS

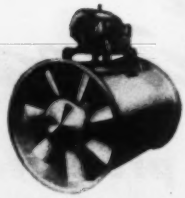
In sizes for pressures up to 4 pounds and capacities up to 75,000 c.f.m. Bulletin 3553-A.

BABY CONOIDAL FANS

Compact, for portable or duct-connected service. Quiet, efficient. Bulletin 3499.

INDUSTRIAL EXHAUSTERS

With interchangeable wheels for air exhausting or materials conveying. All-welded. Bulletin 3576.



AXIAL FLOW FANS

For light-duty ventilation and air conditioning service. Compact, non-over-loading. Bulletin 3533-C.

POWER PLANT FANS

Primary, forced draft, induced draft—built for the severest service. Bulletin 3750.

BREEZO FANS

Easy-to-install wall fans. Durable and very economical. 6 sizes. Bulletin 3222-F.

VOLUME FANS

For blowing or exhausting, up to 10″ s.p. 8 discharge positions. Bulletin 3615-A.

BELTED VENT SETS

Compact, "package" fans for duct or free-air delivery. Non-overloading. Bulletin 3720.

"RE" BLOWERS—EXHAUSTERS

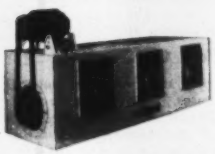
Larger versions of "Buffalo" "E" Blowers, in sizes from 50 to 1600 c.f.m., for pressures up to 40″ of water.

BELT-AIR FANS

Efficient, quiet wall fans for free air delivery up to 19,000 c.f.m. Bulletin 3222-F.

"E" BLOWERS—EXHAUSTERS

For oil or gas furnace blowing, line boosting, cleaning. Bulletin 3014-C.



SHORTBOY VENTILATING SETS

New high efficiency all-aluminum blowers with hollow shaft. Bulletin 3701.

There's a "Buffalo" FAN For The Results YOU Want!

With the complete line of "Buffalo" centrifugal, axial flow and propeller fans, you can pick your fans to pin-point specifications! You can pick the *right* fan for the volume desired—for pressure to be encountered—for the conditions of heat, moisture, cold, abrasion or corrosion expected. And with every "Buffalo" Fan, you get that careful engineering and construction that always means a satisfactory job. For the exact results you want, look to "Buffalo," First for Fans.

WRITE FOR ENGINEERING BULLETINS

AND IT'S "Buffalo" FOR CENTRIFUGAL PUMPS

You'll find a full line of single and double-suction pumps to handle *your* liquids under *your* conditions. For all details, write:

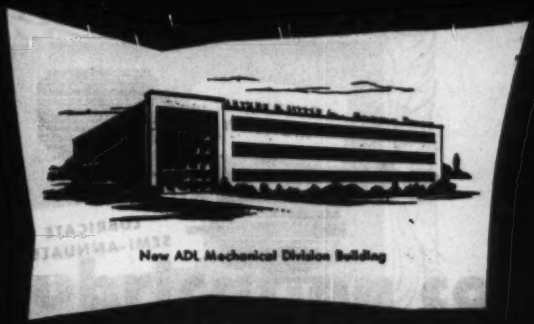
BUFFALO FORGE COMPANY and BUFFALO PUMPS, INC.

148 Mortimer St., Buffalo, New York

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.
Canada Pumps, Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

"Buffalo" FIRST FOR FANS



New ADL Mechanical Division Building

UNIQUE PROTOTYPE DEVELOPMENT

. . . using advanced Engineering Techniques

Design and construction of 400 gallon capacity vessels to contain liquefied gases near 400 degrees below zero F was a recent example of ADL prototype development.

Reducing costly evaporation losses took high-vacuum insulation at a pressure of 1 x 10^{-6} mm Hg, as well as knowledge in extreme low temperature engineering — even under severe transportation heat leaks of only 1/12 watt/sq. ft. occurred.

ADL experience in many areas of science and engineering produced this unique prototype.

If lack of personnel has halted development of your new ideas or new products, the ADL Mechanical Division can take over and bring them to complete maturity.

Arthur D. Little, Inc., has blended its scientific and engineering skills in the Mechanical Division to provide industry with a unique service . . . prototype development of equipment requiring a high level of engineering. Scientists in the fields of chemistry, physics, metallurgy, mathematics, biology, electronics and technical economics can be called on as required.

Our staff is experienced in interpreting the ideas of industry and following through with the perfection of specialized equipment.

THERMODYNAMICS · HEAT TRANSFER · REFRIGERATION TO MINUS 456 F · VACUUM ENGINEERING · GAS LIQUEFACTION · ELECTROMAGNETISM · MECHANICAL DESIGN · VIBRATION

Write for Brochure ME 16-1

MECHANICAL DIVISION

Arthur D. Little, Inc.

CREATIVE TECHNOLOGY SINCE 1886

ADL Mechanical Division

30 MEMORIAL DRIVE, CAMBRIDGE, 42, MASS.

WHAT *Life-Lines* REALLY DELIVER IS MORE SERVICE...LESS SERVICING

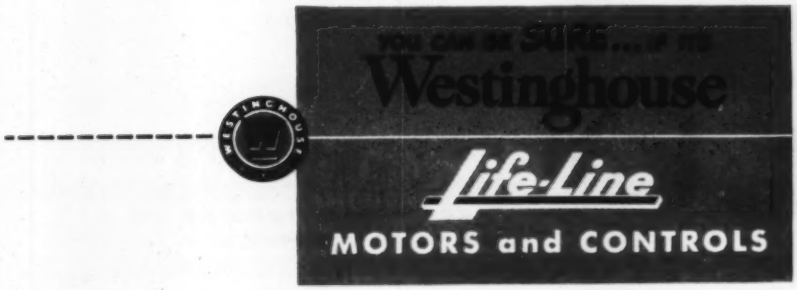
Eliminate "lubrication confusion" with this modern motor!

Some motors require lubrication monthly, others yearly, still others have no definite schedules. They "just need it when they need it". It takes no great stretch of the imagination to see that schedules for greasing under these conditions pose a real problem. How can you do an accurate job? How do you eliminate overgreasing or undergreasing? In short, how do you eliminate these causes of failures?

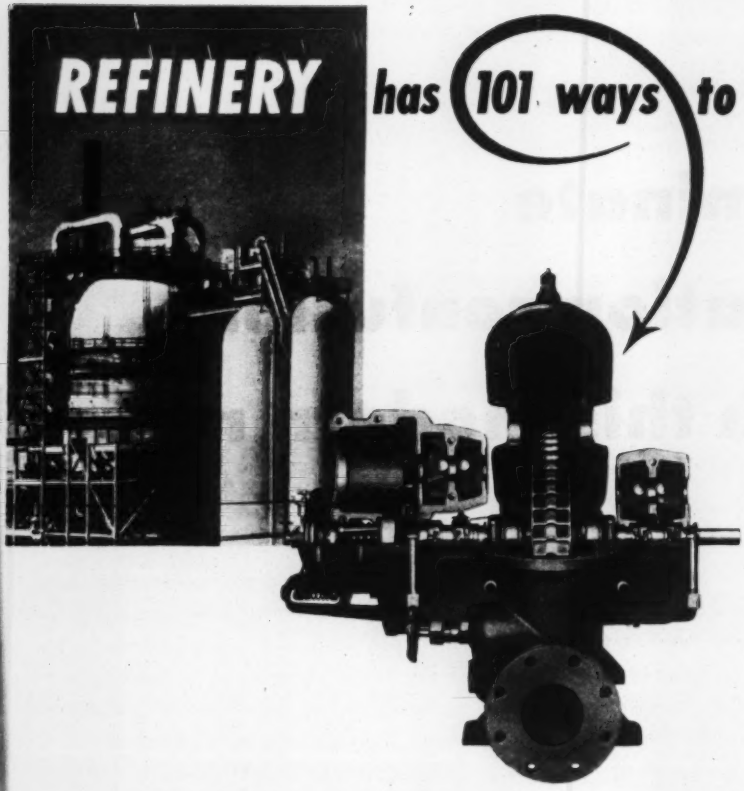
One sure way: install modern *pre-lubricated* Life-Lines. Throw your schedules and grease guns away. The way to grease a modern motor is don't! Pre-lubricated Life-Lines *need no* further *lubrication.*

Records of over half-a-million motors, operating in every type of industry, show that pre-lubricated bearings offer 41% fewer motor outages due to faulty lubrication and at the same time give complete freedom from lubrication attention.

Today periodic lubrication is a costly, time-consuming nuisance. So why take a chance with it? Life-Line offers positive lubrication at no extra cost. See for yourself. Ask your Westinghouse representative for a copy of "Facts on Pre-lubricated Bearings", B-4378, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21694



REFINERY has 101 ways to save money



When the yearly cost of replacement parts for 101 steam turbines averages *only 1.6% of the initial investment*, you are saving money . . . and plenty of it.

This amazing record was established by Terry turbines at a large refinery on the Atlantic coast. The percentage figure was determined by means of an accurate tabulation of the cost of replacement parts required over a two-year period.

These 101 Terry machines provide a good cross section of the various types of small and medium-size turbines made by the company. Ranging in size from 10 to 1200 horsepower, they include single and multistage axial flow designs as well as the famous Terry solid-wheel turbine.

Such outstanding performance records are not at all unusual for Terry turbines. The thousands and thousands of these machines installed in refineries throughout the world provide an accurate yardstick for measuring turbine reliability.

Send for illustrated bulletins. No. S-116 describes the many advantages of the Terry solid-wheel turbine. For multi-stage turbines, ask for a copy of Bulletin S-146.

TERRY

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1194

FOR SUPERIOR Coatings

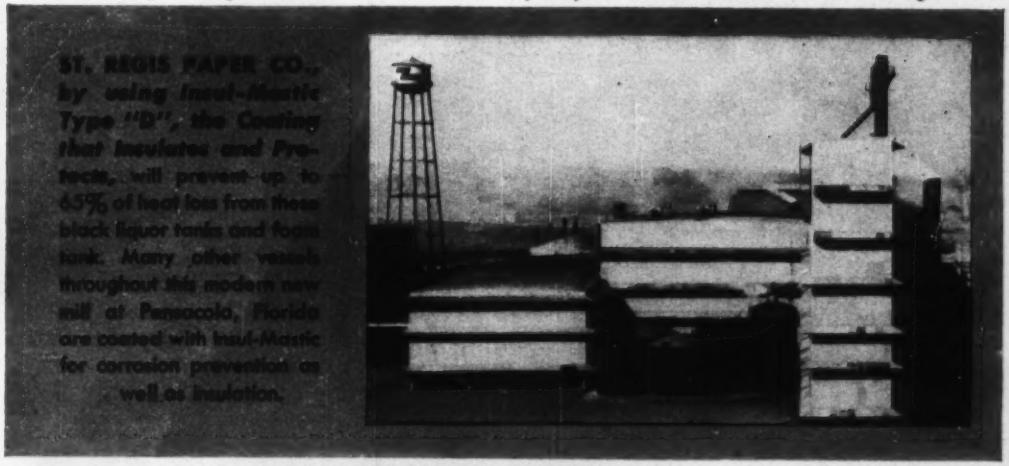
think first of the coatings that last!

INSUL-MASTIC

Corrosive conditions in paper pulp mills and steel mills are terrific. The atmosphere in these plants is charged with acids and alkalis that eat the heart out of steel in a few years—or even a few months. INSUL-MASTIC *superior* COATINGS are giving protection that will last for years to this costly metal equipment in these extremely corrosive places.

In other industries also, Insul-Mastic Gilsonite Coatings are being specified because of their resistance to chemicals and moisture vapor; their minimum shrinkage and great temperature range.

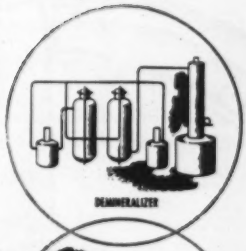
For long coating life under severe conditions specify INSUL-MASTIC *superior* Coatings.

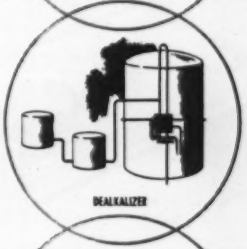

ST. REGIS PAPER CO., by using Insul-Mastic Type "D", the Coating that Insulates and Protects, will prevent up to 65% of heat loss from these black liquor tanks and foam tank. Many other vessels throughout this modern new mill at Pensacola, Florida are coated with Insul-Mastic for corrosion prevention as well as insulation.

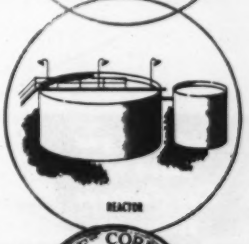
Insul-Mastic Corporation
OF AMERICA
1157 OLIVER BUILDING · PITTSBURGH 22, PA.
Representatives in Principal Cities

cochrane
water conditioning

STARTS WHERE NATURE STOPS







Nature's purest water will not meet the stringent requirements of modern industrial processing. The presence of minerals, salts or gases makes it unsuitable or uneconomical for direct use. Profitable elimination of corrosive or process retarding elements requires specialized experience such as furnished by Cochrane Water Engineers.

Engineering wisdom dictates that it is not so important to know all the answers as to know where to get them. The problems of Ion Exchange, Demineralization, Deaeration, Dealkalization, and others are complex; and there is only one *best* solution to any set of conditions. That's why leading engineers and consultants call on Cochrane for the answers.

To any water conditioning problem Cochrane contributes 89 years of accumulated "know-how". Whether your requirements are for process water or boiler feedwater, Cochrane can show you how to obtain them—economically and efficiently. And since Cochrane manufactures all types of water conditioning equipment, you are assured unbiased recommendations.

When you have a water conditioning problem call on Cochrane. Your requirements will be thoroughly surveyed by a Cochrane Water Engineer . . . then you'll know you're right. To give you prompt consultation and service, Cochrane Water Engineers are strategically located in 29 cities throughout the United States. Write today for the address of our office nearest you.

HOT PROCESS SOFTENERS • HOT and COLD ZEOLITE SOFTENERS • DEAERATORS and OPEN HEATERS • DEMINERALIZERS • DEALKALIZERS • DEGASIFIERS • REACTORS and CLARIFIERS • CONTINUOUS BLOWOFF SYSTEMS • STEAM SPECIALITIES • CONDENSATE RETURN SYSTEMS

cochrane
corp. 3142 N. 17TH STREET, PHILADELPHIA 32, PA.

In Canada: Canadian General Electric Co., Ltd., Toronto
In Mexico: Babcock & Wilcox de Mexico, S.A., Mexico City
In Europe: Recuperation Thermique & Epuration, Paris

COCHRANE CORPORATION WATER ENGINEERS FOR 89 YEARS 1863 - 1952

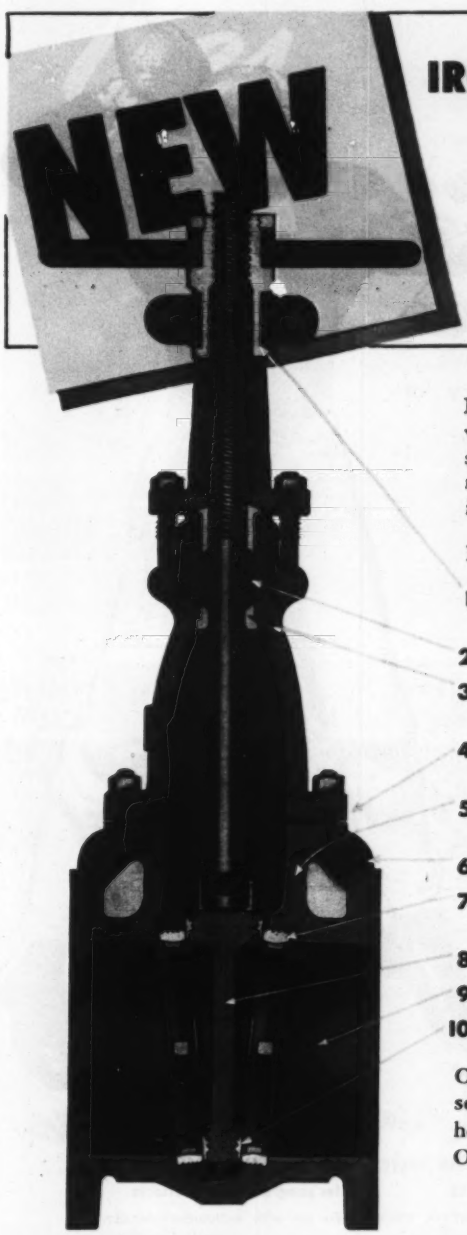
PORTER-CABLE reduces weight and cost with PARKER DIE CASTINGS—

PORTER-CABLE, one of the best known names in the power tool field, is using Parker Aluminum Die Castings on their No. 106 Finishing Sander. Again Die Castings have proved to be the most economical production method, minimizing the need for machining operations. In all portable tools, weight is an important consideration. Here, aluminum die castings were selected for the motor housing, cover and handle in a successful effort to keep weight at a minimum. Parker can produce quality castings for you, too—in aluminum, brass, bronze or zinc. Submit your next requirements to Parker. Our engineers can help you in the earliest stages of your product development.

and when you think of Die Castings THINK OF

Parker White-Metal Company • 2153 Medinah Ave. Erie, Penna.

PARKER ALUMINUM *and* ZINC *Die Castings*



IRON VALVES that give you Steel Valve Features

OIC

NOW the workhorse of the family—OIC's iron valve—offers you features formerly found only in steel valves. It's a brand new valve built around more than a third of a century's experience in making iron valves. We kept only the old handwheel.

Examine these construction details:

1 Lubricated yoke bushing, renewable without removing bonnet.

2 Deeper stuffing box; longer packing life.

3 Inserted back seat bushing permits repacking under full pressure.

4 Stronger body-bonnet joint; uniform gasket compression.

5 Better metal distribution, reduced weight, increased strength.

6 Sturdy tie-ribs; added resistance to pipeline stresses.

7 End-seated bronze seat rings will not loosen in service.

8 I-Beam type solid wedge, accurately guided.

9 Straight-through port areas reduce flow resistance.

10 Rolled-in seat facings on wedges give longer life.

OIC's new line of Iron Valves gives longer service, lower upkeep and greater security. They help you build a more stable valve business. The Ohio Injector Company, Wadsworth, Ohio.

OIC

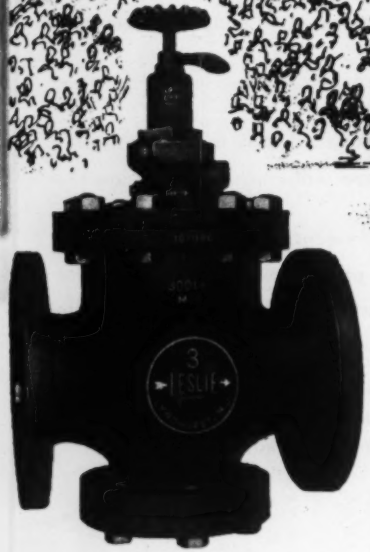
VALVES

FORGED AND CAST STEEL · IRON · BRONZE

Dependable Control...

The same unerring control
that directs a pass into the waiting arms of a speeding end is a "built-in" advantage of every LESLIE Regulator. In automatic controls, as in sports, it's quality that makes the difference.

The fundamental principles of quality design, quality materials, quality manufacture, quality performance and quality service all combine to make LESLIE a logical choice for long-lasting, accurate, trouble-free pressure, temperature, or liquid level control.



Class L-3
Pressure Reducing Valve

TRADE LESLIE MARK

PRESSURE REDUCING VALVES	—For Steam, Air or Gas.
PUMP GOVERNORS	—For pump discharge pressures.
DIAPHRAGM CONTROL VALVES	—For use with instrument controllers.
TEMPERATURE REGULATORS	—For process heating or cooling.
CONTROL PILOTS	—For pressure, temperature, and level control.

SELF-CLEANING STRAINERS • AIR HORNS • STEAM WHISTLES

LESLIE CO. 287 Grant Avenue, Lyndhurst, New Jersey

Write for illustrated bulletin on type of regulator desired. 1708

QUALITY REGULATORS FOR OVER HALF A CENTURY

yes

This old problem has a new solution!

When varied filing capacity must be provided at any point, you can get it with Hamilton UnitSystem equipment—*with no loss of efficient operation or attractive appearance.* For UnitSystem permits the smooth intermixing of various special purpose Hamilton units into a single-bank assembly. Here's the way to do away with "not quite right" filing capacity, easily and at surprisingly low cost.

Let your Hamilton Representative show you how UnitSystem can improve your filing operation—or—use the handy coupon below to get further information on Hamilton UnitSystem filing equipment.

HAMILTON WORK-DESIGNED DRAFTING EQUIPMENT

Hamilton Manufacturing Company

TWO RIVERS, WISCONSIN

from qualitative indicators
to *precision measuring* devices . . .
with the *new*

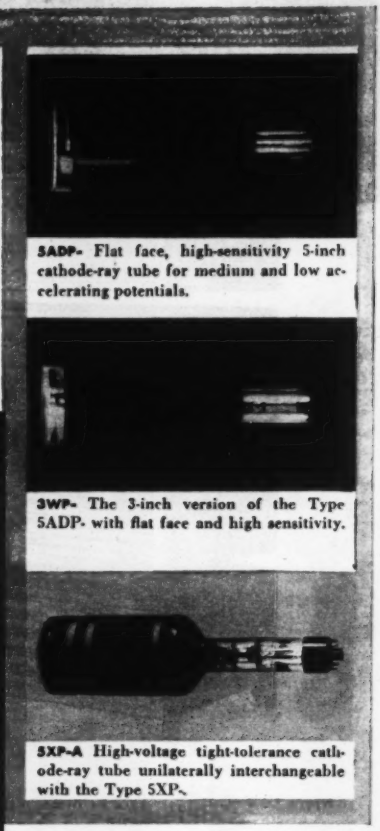
tight-tolerance

CATHODE-RAY TUBES
by
DU MONT

Compare the first of the new Du Mont line of high-precision cathode-ray tubes, the Types 5ADP- and 3WP- with similar cathode-ray tubes, previously available. Notice the improved resolution without loss in brightness, the greatly tightened tolerances on all critical specifications, the greatly increased sensitivity, and the characteristics now specified that have never before been published:

ITEM	5CP-A	5ADP-	3GP-	3WP-
Angular Alignment	90° ± 3°	90° ± 1°	90° ± 3°	90° ± 1°
Grid Cutoff per Kv of Eb2	30V ± 50%	30V ± 25%	33V ± 50%	40V ± 25%
Deflection Factor DCV/in/KV of Eb2 D1D2 D3D4	 46V ± 15% 39V ± 15%	 30V ± 10% 23V ± 10%	 80V ± 20% 70V ± 20%	 46V ± 10% 32V ± 10%
Line Width	No spec	.03" max.	No spec	.028" max.
Pl Light Output	No spec	15 ft. L. min.	No spec	7 ft. L. min.
Modulation[1]	No spec	45V max.	No spec	50V max.
Deflection Non-Linearity	No spec	2% max.	No spec	2% max.
Pattern Distortion[2] Square size A Square size B	No spec	 3.075" 2.925"	No spec	 2.050" 1.950"
Minimum Useful Scan D1D2 D3D4	 ± 2¼" from center ± 2¼" from center	 ± 2" from center ± 2" from center	 ± 1⅜" from center ± 1⅜" from center	 ± 1¼" from center ± 1⅛" from center
Face Plate	Curved	Flat	Curved	Flat

[1] The amount of grid voltage required to drive the tube from cutoff to specified light output.
[2] With a raster pattern adjusted so that wider points just touch Square A, no point will lie within Square B.



5ADP- Flat face, high-sensitivity 5-inch cathode-ray tube for medium and low accelerating potentials.

3WP- The 3-inch version of the Type 5ADP- with flat face and high sensitivity.

5XP-A High-voltage tight-tolerance cathode-ray tube unilaterally interchangeable with the Type 5XP-.

** Available in Production Quantities write for prices*

ALLEN B. DU MONT LABORATORIES, INC.
1500 Main Ave., Clifton, N. J.

BOEING'S 7 LEAGUE BOOTS MAKE "HAPPY LANDINGS"

More and more airframe manufacturers are turning to CHIKSAN Aero-Hydraulic Swivel Joints and assemblies — to insure maximum safety, dependability and economy in their flexible lines.

Boeing's B-47 STRATOJET Bomber, the fastest known bomber in the world, relies on CHIKSAN Aero-Hydraulic Swivels to bring this 185,000 pound sky-giant to feather smooth stops.

Boeing's complete confidence in CHIKSAN Aero-Hydraulic Swivel joints' performance is confirmed by their selection of Chiksan joints for Boeing's B-47; B-50 and B-52 — three giants of the air lanes.

The requirements of each airframe manufacturer become the subject of specialized study by CHIKSAN's Engineering, Research and Development Division. Hydraulic Joints and Assemblies are designed to meet each individual requirement. Designs are available for all aircraft applications handling hydraulics, fuels, oils, water, air, oxygen and other fluids.

Write CHIKSAN today for Catalog 2A "Aircraft Swivel Joints" — Dept. 11-ME

The Flow of Enterprise Relies on

CHIKSAN

CHIKSAN

Ball-Bearing Swivel Joints

Representatives in Principal Cities

CHIKSAN Aero-Hydraulic swivel joints and assemblies for 1000 to 3000 psi systems surpass all standards set down for both civilian and military use.

CHIKSAN low torque joints are also used in conjunction with rubber hose. This combination, utilizing the CHIKSAN swivel action at end of hose, provides flexibility and reduces kinking, twisting, and tearing of the hose.

CHIKSAN Aero-Hydraulic swivel joints and assembly used on the Boeing B-50 braking system.

CHIKSAN COMPANY • BREA, CALIFORNIA • Chicago 28, Illinois • Newark 2, New Jersey

Well Equipment Mfg. Corp. (Division), Houston 1, Texas • Chiksan Export Company (Subsidiary), Brea, California • Newark 2, N. J.

Chapman Casts World's Largest Stainless Gate Valve

9-ton casting produced in austenitic chromium-nickel stainless steel

This valve, produced by The Chapman Valve Manufacturing Co., Indian Orchard, Mass., for the defense effort, is used in corrosive water service. It is stated to be the world's largest, with an overall height of 19 feet, weighing approximately 18,000 pounds. The rough casting weight was approximately 36,000 pounds.

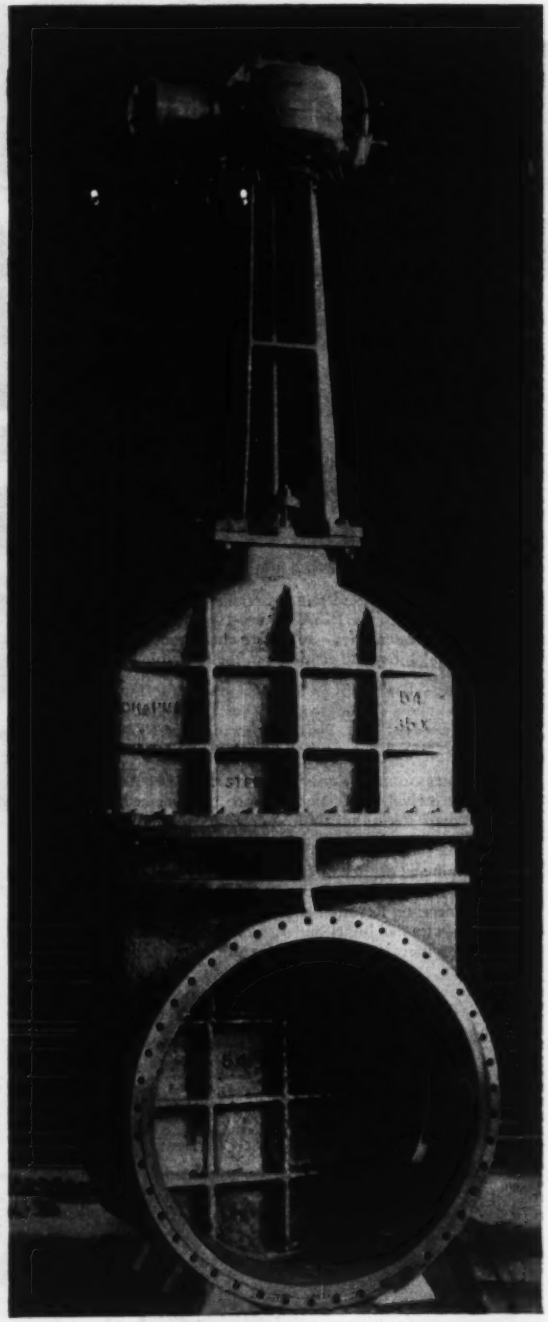
Cast in low carbon 18-8 chromium-nickel stainless steel, it is one more demonstration that size is no limiting factor when you cast parts in stainless steels to provide resistance to corrosion and erosion.

Stainless steel resists attack by nearly all oxidizing acid conditions. In addition, it helps you trim bulk and deadweight without sacrificing strength and safety.

At elevated temperatures, austenitic chromium-nickel stainless steels are distinguished by their strength and outstanding resistance to oxidation. At temperatures down to −320° F. they retain their toughness and unusual strength.

Investigate all the benefits stainless steels can give you. Leading stainless steel companies and foundries produce nickel-containing stainless steels in all commercial forms. A list of sources of supply will be furnished on request.

At the present time, the bulk of the nickel produced is being diverted to defense. Through application to the appropriate authorities, nickel is obtainable for the production of austenitic stainless steels for many end uses in defense and defense supporting industries.



THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 74 NUMBER 11

Contents for November, 1952

100 YEARS OF ENGINEERING 867
STRONGER ENGINEERING GRADUATES . . . . . *G. E. Doan* 877
MODERN HIGH-PRESSURE HIGH-TEMPERATURE BOILERS—2 . . . . . *G. W. Kessler* 878
BEARINGS, LUBRICANTS, AND LUBRICATION—A DIGEST OF 1951 LITERATURE 885
MANPOWER UTILIZATION AND NATIONAL SECURITY . . . . . *C. H. Brown* 892
THE ASME BOILER CODE
IV—ASME EXPANDS THE BOILER CODE—1919–1924 . . . . . *A. M. Greene, Jr.* 897

EDITORIAL 865
BRIEFING THE RECORD 909
ASME TECHNICAL DIGEST 919
CONTENTS OF ASME TRANSACTIONS . . 928
COMMENTS ON PAPERS 929
REVIEWS OF BOOKS 931
BOOKS RECEIVED IN LIBRARY 932
ASME BOILER CODE 933
ASME NEWS 935
ASME JUNIOR FORUM 951
ENGINEERING SOCIETIES PERSONNEL SERVICE . . . 954

BUYER'S CATALOG GUIDE 43
CLASSIFIED ADVERTISEMENTS 158
CONSULTANTS 166
ADVERTISERS 168

OFFICERS OF THE SOCIETY:

R. J. S. PIGOTT, *President*
J. L. KOPF, *Treasurer* C. E. DAVIES, *Secretary*
E. J. KATES, *Assistant Treasurer*

PUBLICATIONS STAFF:

GEORGE A. STETSON, *Editor* S. A. TUCKER, *Publications Mgr.*
K. W. CLENDINNING, *Managing Editor* J. M. CLARK, *Business Mgr.*
M. MARTY, *Asst. Business Mgr.*
J. J. JAKLITSCH, JR., *Technical Editor* E. S. NEWMAN, *News Editor*

PUBLICATIONS COMMITTEE:

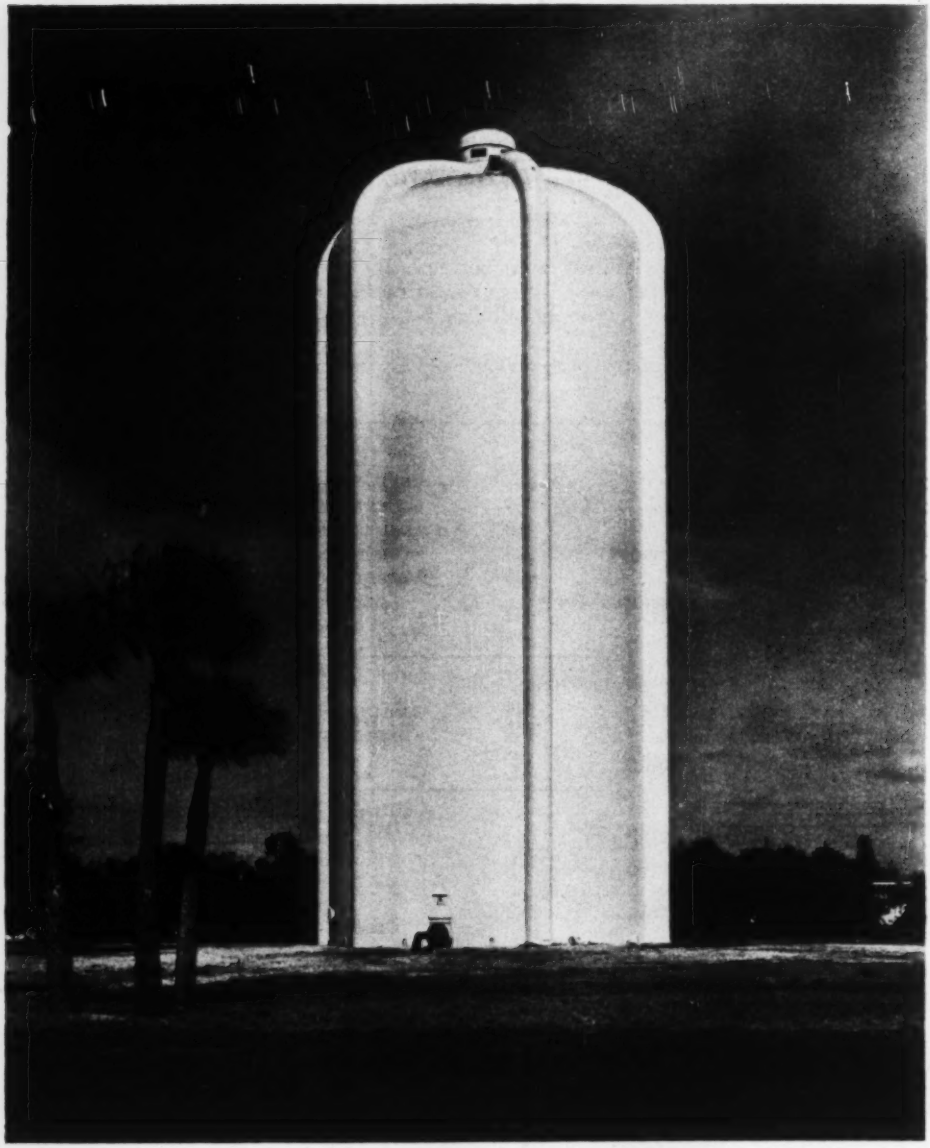
C. B. CAMPBELL, *Chairman*
GEORGE R. RICH OTTO DE LORENZI
PAUL T. NORTON, JR. COLIN CARMICHAEL
MORRIS GERR, JOSEPH SCHMERLER } *Junior Advisory Members*

REGIONAL ADVISORY BOARD OF THE PUBLICATIONS COMMITTEE:

KERR ATKINSON—I W. E. REASER—III HENDLEY BLACKMON—V R. G. ROSHONG—VII
JOHN DE S. COUTINHO—II F. C. SMITH—IV CHESTER R. EARLE—VI M. A. DURLAND—VIII

Published monthly by The American Society of Mechanical Engineers. Publication office at 20th and Northampton Streets, Easton, Pa. Editorial and Advertising departments at the headquarters of the Society, 29 West Thirty-Ninth Street, New York 18, N. Y. Cable address, "Dynamic," New York. Price to members and affiliates one year $3.50, single copy 50 cents, to nonmembers one year $7.00, single copy 75 cents. Extra postage to countries not in the Pan-American Union, $1.50; to Canada, 75 cents. Changes of address must be received at Society headquarters four weeks before they are to be effective on the mailing list. Please send old as well as new address. . . . By-Law: The Society shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B13, Par. 4). . . . Entered as second-class matter at the Post Office at Easton, Pa., under the Act of March 3, 1879. . . . Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921. . . . Copyrighted, 1952, by The American Society of Mechanical Engineers. Member of the Audit Bureau of Circulations. Reprints from this publication may be made on condition that full credit be given MECHANICAL ENGINEERING and the author, and that date of publication be stated.

MECHANICAL ENGINEERING is indexed by the Engineering Index, Inc.



View of 1,000,000-gal Standpipe, 43 ft × 95 ft to the High-Water Line, Built for Clearwater, Fla., by Chicago Bridge & Iron Company

MECHANICAL ENGINEERING

VOLUME 74
No. 11

NOVEMBER
1952

GEORGE A. STETSON, *Editor*

Top Executive Speaks

SPEAKING at a joint luncheon of the American Society for Engineering Education and the Engineers' Council for Professional Development held in Chicago during the recent Centennial of Engineering, E. G. Bailey began his address by saying: "My answer to the question, 'Can engineering graduates man a company?' is yes, because they are doing it very creditably in many cases." The important point, he said, was "How can each of us study the many cases at hand and draw some helpful conclusions regarding college curricula, selection of graduates, training, promotion, and organization of engineers for the best interests of our industrial economy?" Mr. Bailey closed his address by saying: "The engineering profession should present to the top executives of American industry illustrations and factual data relating to the successful use of engineers in such an effective manner that all will strive to improve their present methods for selecting, training, and advancing engineering graduates within their respective companies."

Now it just so happened that a "top executive of American industry," John F. Gordon, vice-president of General Motors Corporation, also addressed the ASEE and ECPD at Chicago and presented "factual data relating to the successful use of engineers," which our readers will find interesting enough to broadcast.

"In General Motors," Mr. Gordon said, "we regard engineering as a career of unparalleled opportunity for the young man leaving a technical college. It is a career of challenging assignments, of interesting problems, of pleasant working conditions. There is really no limitation on progress or financial compensation as evidenced by the fact that the Chairman of the Board of Directors, the president, and about half of the vice-presidents also started their careers as engineers. They have progressed through the organization as civil, electrical, or mechanical engineers into their present executive positions. Moving a little lower on the scale of corporation authority shows a remarkably high percentage of engineers in positions of great responsibility in the divisions as general managers, works managers, chief engineers, and plant managers. These facts assume even greater significance when it is realized that graduate engineers represent less than two per cent of the employees and all of our men classified as engineering employees do not add up to five per cent of the total."

Mr. Gordon went on to say that there was no specific procedure which made it easy for the engineer to achieve such status in the corporation and added that "promotion into important executive positions of engineering personnel is considered one of the major reasons contributing to the phenomenal growth of General Motors during the past 25 years."

Mr. Gordon expressed confidence that "the same form of progress will continue on an accelerated basis because the percentage of engineering personnel to other employees should continue to increase and show a correspondingly greater contribution to our corporate success." Even though some men might not finish their engineering studies, he pointed out, "a good percentage of such students will have gone far enough in their studies to learn the fundamentals of the engineering approach to problems and will find employment in which they can make valuable contributions. From a long-range standpoint we need graduate engineers who can handle the problems of product design and development but we also need those who can apply the engineering approach to the problems of production, business administration, sales, and human relations, even though they may not be graduate engineers."

In explaining the General Motors method of determining the number of college graduates needed each year, Mr. Gordon said that "the field of engineering education comprised 86 per cent of the group requested for recruitment in 1952." He spoke also of the General Motors Institute which "is now the focal point of our training activities for the entire corporation." In the past four years, 1948–1951, figures showed 1093 General Motors Institute men employed and 1067 other engineering-college graduates.

Speaking of the young engineers employed he said: "In a sense they are the partially processed personnel material out of which will come many of our ranking engineers and executives of the future. Thus it is our responsibility to establish procedures which will assist the graduate in his introduction to industrial employment and at the same time maintain him in an environment which will stimulate and promote his growth. Provided with these helps, it is still required of the individual employee that he take the initiative in self-development through use of the opportunities that are presented to him."

Mr. Gordon recognized the fact that "any large corporation is an organization of many people in which no single individual is apt to reach his personal objective without the voluntary co-operation and assistance of his associates." This calls for teamwork. "Few indeed are the industrial positions wherein an engineer can work as a 'lone wolf.' If he honestly wishes to progress, he must be able to adapt himself to the organ-

ization in a wholehearted manner. He must learn to work with people until his responsibilities increase to such an extent that the major requirement is for people to work with him."

Three requirements were cited by Mr. Gordon as essential components of a successful career:

"The graduate's native abilities such as health, energy, imagination, intelligence, initiative, and comparable characteristics.

"The graduate's ability to understand and use the known laws of the arts and sciences.

"The graduate's understanding and appreciation of the so-called 'unwritten laws' of the practice of engineering by which his own efforts are integrated into the larger field of industrial production."

In commenting on the third of the foregoing components, Mr. Gordon said: "It is only in the last few years that I have not been devoting all of my time to the practice of engineering. I mention those years of professional experience in order to place proper emphasis on this statement: Very few of the engineers I have known failed to progress due to insufficient technical ability. Many have been found lacking in personality or personal characteristics and their lack of development classed as professional failure. The price of these failures is large at any time, but it grows greater when the man is allowed to move along in the organization for some time before his shortcomings are evident. We try to avoid such mistakes . . . . by frequent appraisal of each individual in the program by expert counseling aimed at correction and by continuous association with experienced engineers."

Being a graduate of an engineering school is not enough to insure the maximum success a young man desires to achieve and his employer hopes he will achieve. As Mr. Gordon said toward the end of his address he had talked about "some of the things we believe are important for *self-development*. "This concept of an individual 'developing himself' as opposed to 'being developed' by the company recognizes that no one is foreordained to become an executive although we strive to achieve that result over a period of years."

Such was the testimony of a top executive on the successful use of engineers.

ECPD Training Program

ANNOUNCEMENT at the 1952 Annual Meeting of the Engineers' Council for Professional Development to the effect that the 1950 report of the Committee on Training which outlined a program called "The First Five Years of Professional Development" is to be tried out on a community-wide basis in the greater Cincinnati area is good news to all friends of engineering education and young engineers.

The Training Committee's report, which has frequently been mentioned in this magazine, was dramatically presented at the 1950 ECPD Annual Meeting in Cleveland. It will be recalled that the program proposed was based on the thesis that education is a continuing experience, begun in school and college and extending throughout a man's lifetime. Because of the sharp termination of formal education at graduation and the new experiences which come with entry into a career in industry, many young men undergo what is known as a postcollege slump. If they are fortunate enough to obtain employment with a concern which has a well-developed training program, these young engineering graduates may find it natural and easy to continue their education. In some favorable circumstances they may be encouraged to supplement such in-company training as their employers may offer with postgraduate studies at a college or university in their community. Circumstances may even afford them the opportunity, incentive, and encouragement to further other aspects of their professional development. But the majority of graduates do not find themselves in such favorable environments, and many companies cannot, or do not, offer the opportunities so splendidly developed by some of the larger and more progressive companies. Hence, the establishment in a community of a well-planned program of professional development, which covers the many and varied aspects that are important to the young man, can call upon the combined co-operative efforts of all the employers, on the educational institutions, on the sections of engineering societies, and local organizations of engineers, and on all other elements of the community, such as churches and civic organizations, which also have much to offer the young newcomer in their midst.

The Training Committee's report outlined a six-point program: (1) Orientation and training in industry; (2) continued education for graduate engineers; (3) integration of the young engineer into the community in which he has taken up residence; (4) aid and encouragement of the young engineer toward the attainment of a license to practice as a registered professional engineer; (5) self-appraisal methods as a basis for career planning; and (6) reading lists for broadening the individual in technical and nontechnical fields.

The implementation of such an ambitious program demands careful direction of the numerous community employers and organizations in a co-operative effort, and a "pilot-plant" operation in an appropriate community. Cincinnati has offered the opportunity for the ECPD Training Committee to try out its program under favorable conditions. A group of nationally known industrialists will sponsor the program locally under the general supervision of Prof. Cornelius Wandmacher of the University of Cincinnati who has energy, enthusiasm, and faith in its objectives and has been closely associated with ECPD in recent years, and is currently chairman of the ECPD Training Committee. In announcing the decision to implement the plan, the president of the Engineering Society of Cincinnati, one of the oldest in the nation, said: "Cincinnati has been designated as a community where excellent conditions for professional development already exist and where there already is splendid supporting activity among the engineering societies, industry, and the University, these three being the three major factors in any program of this sort."

100 YEARS OF ENGINEERING

A Report of the Centennial of Engineering Held at Chicago, Ill., Sept. 3–13, 1952

AN EVENT as stupendous and significant as the Centennial of Engineering, held in Chicago, Ill., Sept. 3 to 13, 1952, to commemorate the one-hundredth anniversary of the founding of the American Society of Civil Engineers, deserves to be recorded as amply as space and the limitations of a single observer will permit. Months of planning by hundreds of organizations and individuals culminated in a combined program so vast and varied that it was physically impossible for any individual to attend more than a small number of the scheduled events. Crowded into those few days were not only the events of general interest and popular appeal, but the technical sessions of some sixty-odd organizations who seized upon the Centennial as an opportunity of holding their own meetings in the atmosphere of this significant occasion. To publish the combined programs of the general events and the special meetings, a pamphlet of 264 pages was necessary. By means of this Convocation Program the individual engineer was able to survey the complete offerings and make for himself such selections as best suited his interests and convenience.

WHAT WAS BACK OF THE CENTENNIAL

When the American Society of Civil Engineers cast about for an appropriate manner in which to celebrate their centenary, certain facts readily became apparent. They were the first national society of civilian engineers to be organized in the United States. (The Boston Society of Civil Engineers had been organized in 1848.) The name they took and the objectives they sought in 1852 were broad enough to include all national engineering societies subsequently formed, and hence they stand in the position of being the progenitors of the engineering profession in this nation. The ascendency of the self-governing nations, the impact of the natural sciences and industrialization on Western civilization, and the ferment of liberty, opportunity, and hope in the minds of ordinary citizens one hundred years ago gave to the practice of engineering for civilian uses a significance far greater than had ever been attained in its historical role in military affairs. The American Society of Civil Engineers, in planning its Centennial, recognized that "during the past century, the remarkable advancement of our country has been due in a considerable degree to the contributions made by American Engineering and Technology," and that the Centennial celebration afforded "an outstanding opportunity to commemorate the services of the engineering profession to the nation" by bringing "to the people of the United States and the world a more complete understanding of some of the principal reasons why the United States has reached its present high stage of development."

PLAN OF THE CELEBRATION

With the foregoing and other considerations in mind, the American Society of Civil Engineers drew up a bold and comprehensive plan for its Centennial, and broadened the scope so that it became in fact a Centennial of Engineering in the United States, with broad participation by all elements of the engineering profession. To direct the over-all phases of the celebration there was created a nonprofit corporation, Centennial of Engineering, 1952, Inc., with headquarters at the Museum of Science and Industry, Chicago, Ill. Lenox R. Lohr, president of the Museum, acted as president of the Corporation, Carlton S. Proctor, president ASCE, as vice-president, Titus G. LeClair, president AIEE and chairman of Engineers Joint Council, as treasurer, and Charles F. Kettering, as chairman of the executive committee. Directors of the Corporation were chosen from among the past-presidents and other members of the engineering societies which constitute EJC. Money for financing the general features of the celebration was raised through contributions from industrial and manufacturing organizations.

OBJECTIVES OF CELEBRATION

In an Information Circular, issued by W. N. Carey, executive secretary, and E. L. Chandler, assistant secretary, ASCE, in November, 1951, three major aims of the celebration, directed principally to the general public and to foreign visitors, were set forth. "The Centennial will be designed," it was announced, "to make known the contributions of engineers to our national progress. It will depict clearly the role of industry, with its mass production and distribution, so essential to our high standard of living. Above all, it will attempt to demonstrate that an atmosphere of freedom and competition, with competent engineering and management in industry, is essential to maintain and increase the prosperity of the nation."

A quantitative assessment of how successfully these aims were realized is, of course, impossible. To an observer at Chicago, it appeared that the immediate results were more conspicuous in some phases of the vast and varied program than in others. However this may be, there can be no doubt that indirect results will continue to stem from the celebration for years to come. One can only recall the long-term and sometimes subtle influences exerted in the past by such events as the Centennial Exposition in Philadelphia in 1876, and the World's Columbian Exposition in Chicago in 1893 to realize that the Centennial of Engineering in Chicago in 1952 will continue to affect the progress of the engineering profession and the nation for years to come.

POPULAR FEATURES AT THE MUSEUM OF SCIENCE AND INDUSTRY

The more general and popular phases of the celebration were under the direction of the Centennial Corporation. At the Museum of Science and Industry the engineering exhibit occupied more than 10,000 sq ft of space. It was planned "to trace briefly the history of engineering in one industry and to show modern engineering in many industries." Aluminum as a structural material, the significance of mechanized farming, the importance of lubrication, materials handling, lighting, and interchangeable-parts manufacture were among the exhibits. The history of the Civil Engineer Corps of the U. S. Navy was also depicted to show how engineering progress has been valuable to the defense of the nation.

"ADAM TO ATOM"

Also at the Museum was a musical review "Adam to Atom," directed by Helen Geraghty, which portrayed mankind's advance over the ages. In the main Theater of the Museum, public performances were staged twice daily and three times on Saturdays from July 12 to September 28.

Members of The American Society of Mechanical Engineers

and their guests were privileged to witness this performance, and to inspect the Museum exhibits, on the evening of Tuesday, September 9.

FIELD TRIPS

Also under the general supervision of the Corporation were several field inspection trips which gave engineers visiting Chicago an opportunity to see the laboratory of the Portland Cement Association, the Ridgeland plant of the Commonwealth Edison Company, the West-Southwest sewage-treatment works of the Sanitary District of Chicago, and the Indiana Harbor Works of the Inland Steel Company at East Chicago, Ind.

Special tours for the women in attendance at the Centennial were conducted and the ASCE maintained a ladies' reception room at the Conrad Hilton Hotel.

INTERNATIONAL DAY

The opening day of the Centennial celebration, September 3, was designated International Day in honor of the more than 500 engineers from other countries who were in attendance. A reception was held at the Museum, and opportunity was afforded the visitors to inspect the engineering exhibits. After supper had been served, the guests were taken to the Theater for the evening performance of "Adam to Atom." A special feature was the laying of the corner stone of the Museum which occupies a building which was originally erected as part of the World's Fair Exposition in 1893. The stone is to be reopened and its contents examined in 2052.

COMMEMORATIVE POSTAGE STAMP

On Saturday, September 6, the United States Post Office Department issued a commemorative postage stamp honoring "the 100th Anniversary of the American Society of Civil Engineers." Special covers to which these stamps were affixed were made available at the Centennial headquarters at the Conrad Hilton Hotel for the convenience of philatelists and visitors who wished to send these historic stamps to their friends.

CENTENNIAL LUNCHEON

Centennial Day, Wednesday, September 10, was devoted to two events of particular interest to engineers. The Centennial Luncheon, which to many engineers marked the high point of the program under the general supervision of the Corporation, was held in the huge ballroom of the Conrad Hilton Hotel following a reception to the honored guests. Lenox R. Lohr, president, Centennial of Engineering, 1952, Inc., acted as master of ceremonies. The invocation was pronounced by the Rev. Theodore M. Hesburgh, president, University of Notre Dame, and greetings were extended by Martin H. Kennelly, Mayor of the City of Chicago, and by Allan S. Quartermaine, president, The Institution of Civil Engineers, London, England, who said that he spoke on behalf of all engineers from outside of the United States. Carlton S. Proctor, president ASCE, responded to these greetings.

The principal features of the luncheon were the awards of the John Fritz and Hoover Medals, and the address of Ex-President Herbert Hoover.

JOHN FRITZ MEDAL AWARD

The John Fritz Medal, "for notable scientific or industrial achievement," established in 1902 in honor of the distinguished engineer whose name it bears, was awarded to Benjamin Franklin Fairless, president, United States Steel Corporation. Ralph Budd, chairman, Chicago Transit Authority, described the achievements of the recipient and presented him for the award, which was conferred by R. E. Dougherty, chairman, The John Fritz Medal Board of Award.

HOOVER MEDAL AWARD

The Hoover Medal, which was founded in 1929 to commemorate the civic and humanitarian achievements of Herbert Hoover, was conferred on the Right Honorable Clarence Decatur Howe, Minister of Trade and Commerce and Defense Production, Canada. Eugene Holman, president, Standard Oil Company of New Jersey, in presenting Mr. Howe for the award, summarized the high lights of the career of the distinguished recipient; and the medal was conferred by Scott Turner, chairman, The Hoover Medal Board of Award.

Each medalist delivered a brief address, after which Mr. Hoover spoke.

MR. FAIRLESS' ADDRESS: "WANTED: A BETTER WAY"

In accepting the John Fritz Medal, Mr. Fairless spoke of his appreciation of the high honor conferred upon him "No honor which comes to a man in the course of his career," he said, "ever means so much to him as one that is conferred upon him by members of his own profession. . . . .And this one is doubly welcome to me, as a steel man, because it was established in honor of John Fritz—one of the truly great figures in this century of engineering progress that we are celebrating here today."

After speaking of his education, during which he "dreamed of building railroads and bridges and skyscrapers" but actually "started out by building an open hearth and ended up in the steel business," he paid tribute to an education in engineering which "fits a young man for almost any occupation he may wish to pursue in later life."

"I can think of no other profession," he continued, "which places a greater premium upon accuracy and precision. The engineer can never afford to guess at the facts. He cannot assume that a certain girder will withstand about so much stress or that a certain beam will support about so much weight. He must know his facts completely and exactly; and he must be governed by them absolutely, for if he is only 99 per cent right, he is likely to be 100 per cent wrong, and his bridges will end up in the drink.

"And so it is, of course, with anything else which men build —whether it be an open hearth, an economic system, or a government. All of them must be engineered in strict accordance with the facts, and the builder who tries to remodel our economy, and who twists those facts to conform to his personal wishes, his emotional whims, or his political theories, is courting disaster for us all.

"That is why I believe that in every part of our society, America needs, as never before, the disciplined mind of the trained engineer—a mind that is eternally dedicated to the pursuit of truth, and rigidly governed by the facts of our national life. And because you, here, possess that type of mind, I want to discuss with you—a subject which may seem to you to lie far outside the normal scope of the engineering profession, but which, to my way of thinking, is the most important item of unfinished business that confronts us today."

The "unfinished business" to which Mr. Fairless referred was human relations in industry, about which he devoted the major portion of his address.

"I wonder how many of us realize," he asked, "the alarming extent to which our advances in the scientific and engineering fields are now being wiped out by our failure to make similar progress, as a nation, in the field of human relations. Let me give you one startling example among the many hundreds which probably might be cited:

"Since the end of World War II the American steel industry has been engaged in a vast program of expansion which has added an average of about $2\frac{1}{2}$ million tons each year to its

FORMER PRESIDENT HERBERT HOOVER AT THE CENTENNIAL OF ENGINEERING WITH FRIENDS

(*From left to right:* Major Lenox R. Lohr, president of the Centennial of Engineering, Rt. Hon. Clarence Decatur Howe, Canadian Minister of Trade, Commerce and Defense, who was awarded the 1952 Hoover Award; Mr. Hoover; and Benjamin Franklin Fairless, president of United States Steel Corp., 1952 recipient of the John Fritz Medal. The medals were awarded at the Centennial Day Luncheon on September 10.)

ingot capacity. Yet during this same period it has lost about seven million tons of ingot production each year as a result of strikes. That means that for every ton of capacity we have added, we have lost nearly three tons of production.

"At Morrisville, Pa., United States Steel is now building the largest integrated steel plant that has ever been constructed in so short a time; yet it will take this plant ten years to turn out as much tonnage as our nation lost in less than eight weeks, this summer.

"Obviously, the time has come when it behooves all of us to search for a better way to settle our labor disputes. The American people are patient, but they will not sit by forever and permit strikes to endanger our national defense, to impede our industrial progress, and to wipe out the savings of thousands of workers many of whom—in some cases—are not directly involved in the controversy. Ultimately the force of public opinion is going to compel drastic action in Washington—action which can only result in the further suppression of our precious liberties.

"Already we hear it suggested that the right to strike be abolished completely in periods of national emergency. That way, I think, lies slavery, and I do not see how any thoughtful American can support such a proposal.

"Elsewhere we hear an increasing demand for government arbitration of labor disputes. That way, I believe, lies the eventual nationalization of industry and the murder of free enterprise; for it seems clear to me that if wages and other major production costs are to be dictated by any government-appointed agency, then the government itself must soon take over our industries and assume direct financial responsibility for the consequences of its decisions. Should that occur, of course, it would also mean the end of labor's right to strike; for the right to strike against the government is already denied by law.

"So either of these proposals must lead to the suppression of individual freedom and both are therefore fundamentally wrong. I do not mean to suggest, however, that there is no need for government action in this field. There is.

"I believe that government must fix the rules under which the collective-bargaining process is to operate—rules that are fair to both sides and that are enforced, firmly, and without favor. I also believe that some future Congress must face up to the question of labor monopoly just as past Congresses have clamped down on industrial monopoly.

"But I do not believe that political interference with the collective-bargaining process itself can ever produce anything but more industrial conflict. Government intervention does not prevent strikes—it invites them. And it always will as long as one part or the other has a better chance to get a favorable settlement from its political friends in Washington that it has at the bargaining table.

"We learned this under the labor board in the last war. We are learning it again today under the administration of wage and price controls; and if we didn't learn it during the recent steel strike, then heaven knows, we are incapable of learning anything!

"Clearly, we cannot look to government for the final answer to this problem. We must solve it for ourselves. It is a responsibility that rests upon all of us—and especially on management and labor. There must be a better way of settling our differences than just by slugging them out at the expense of the entire nation. There must be a better way of using our freedom than by undermining our ability to defend that freedom. And clearly there is. Our job is to find it.

"I believe that this nation has the right to expect American labor and management to bargain in a spirit of reason and decency. I believe it is fed up to the gills with name-calling, mud-slinging, and personal abuse. I believe it expects labor to use the strike only as a weapon of last resort—not as the opening gun in a campaign for tactical advantage. I believe it expects management to respect and defend the right of its workers to

bargain, voluntarily, through unions of their choosing. I believe it expects both of us to live and to let live—to recognize that our long-range interests are identical, not antagonistic, and that anything which injures one of us will gravely jeopardize the security of the other.

"In short it expects us to substitute co-operation for conflict and to end this industrial warfare once and for all.

"That is a large order. It is a task to challenge the finest minds in the land. It will demand infinite patience and endless perseverance. But if it can be accomplished, it will stand out, I think, as the greatest contribution of this century towards the industrial development of America. And so I commend it especially to your thoughts on this occasion.

"One way to approach this task, it seems to me," he said in closing his address, " is suggested by a passage in the autobiography of John Fritz himself. He writes:

" 'In all my experience, I have always sought to secure and retain the good will of the workmen. With confidence fully established between workmen and their employer, strikes rarely occur.'

"But times, of course, have changed greatly since that was written. In these days of mass production and mass employment, when our plants are scattered from one end of the land to the other, it is practically impossible for employers in a large industry to talk with their men at all . . . to exchange views and to discuss their mutual problems and interests.

"It is this fact, above all else, I think, that has led to the rapid deterioration of our human relations in industry. And that is why Philip Murray and I have agreed to set out, this fall, on a series of trips to the various plants of United States Steel. We plan to sit down at the dinner table with the local representatives of the union, and of the plant management, and talk things over. We want to tell each other our troubles, and help each other to find a solution for them. And we hope, in this way, to stop a lot of the friction at its source. In the end, we may even discover that we're not antagonists after all; but just partners and friends.

"I do not know what luck we shall have. I do not know that we shall accomplish anything at all. But I do know that both of us will sincerely try to find 'a better way.' "

MR. HOWE CALLS ON ENGINEERS TO EXERCISE INFLUENCE ON BROAD NATIONAL POLICIES

Mr. Howe expressed his gratification in receiving the Hoover Medal which, he said, he accepted "as a tribute to Canada and as a gesture of friendship to the engineers who have done so much to build a great nation on the northern half of this continent."

"On an occasion like this," he asserted, "in the midst of centennial celebrations, our minds are inclined to rove back over the years of our own professional experiences, and I am sure my contemporaries feel, as I do, that we have observed, and taken an active part in, the most interesting fifty years of a century of outstanding scientific progress. We have seen a succession of amazing scientific discoveries developed and applied by our professional colleagues. During the same time, we have watched our profession expand its fields of interest and responsibility from the more narrow confines of technical skills and professional specialties to those broad areas concerned with management, high policy, and public affairs.

"These trends in our professional life have been paralleled by, and may even be a result of, the fundamental changes that have taken place in attitudes about national and international affairs on the North American continent. In 1900, the United States was just emerging from a period of unrivaled material growth and development, which had brought within the reach of enterprising men a prosperity that could not be duplicated elsewhere. The general outlook of most of us was that of the vigorous and successful pioneer, who was still busy developing his own business, and providing for his own financial security. We assumed—quite understandably—that our destiny depended upon our own individual efforts, and little else. Small wonder that fifty years ago there was widespread support for the idea that personal industry and prudence were enough to guarantee security, individually and nationally.

"There was a logical desire to be left alone to develop one's own life and fortune, amidst the abundance of natural wealth that lay at hand. That appeared to be the road to both peace and prosperity. But we have all, I think, been forced to the conclusion, by the harsh realities of our times, that neither men nor nations can afford to remain unconcerned about the destiny of other men, or other nations.

"We, as engineers, by our technological achievements, took a prominent, if unconscious, part in bringing about this change of attitude. It was the application of our technology that made the world smaller and more interdependent. It seems to me that, in turn, we must and should take an active part in the attempt to solve the problems we have helped to create.

"A century ago, it was possible for a nation to overlook great inequalities within its own borders. For the most part, such inequalities were regarded as inevitable, even though unfortunate. Today, at least in developed nations, we no longer pass by on the other side when confronted by regional calamities, depressed areas, or impoverished groups. It has become a cardinal principle of our national life to keep the body politic alive and vigorous in all its parts. For we have come to realize that weakness in one vital part is a threat to the well-being of the whole.

"So it is in the relations between nations, although the revolution in thought, which we accept in national affairs, makes less rapid progress in international affairs. Your great country, I am glad to say, is giving a lead. Speaking for Canada, I would like to say that we take great pride in being able to march with you, and to carry our share of the burden. In a world where at times the future looks depressingly somber, the brightest ray of hope comes from the wholehearted and generous assumption of international responsibility, which has transformed the United States in a few years from a virile, vigorous youth, with few outside responsibilities, to an equally vigorous and powerful adult, with all the great responsibilities of leadership in a family of free nations.

"These trends have a special significance for engineers. A century ago, civilian engineers were essentially technicians, in the broad meaning of that word. They were able, competent, and enterprising. But for the most part their interest lay in designing, constructing, and operating. The decision as to whether, why, and when works were to be undertaken, and how they were to be operated were usually taken by others. Even when I graduated, the fields of management and policy direction in industry were being entered by only a few enterprising engineers with strong pioneering urges.

"We all know what has happened during the past fifty years. The pendulum has swung full over, and it is the rule today, rather than the exception, that engineering-trained executives are to be found in the highest managerial posts of major industries. If any should doubt that claim, all he need do is look around this distinguished gathering to realize that not only technical questions, but the highest policy decisions, which have placed this country at the top of industrial effectiveness, are today being made by men of our professional training.

"America, however, was not the first country where scientifically trained men directed the national industrial machinery. In pre-war Germany, when her industrial strength was at its zenith, practically all industrial company directors of their

CENTENNIAL OF ENGINEERING LUNCHEON, SEPTEMBER 10, DURING PRESENTATION OF THE HOOVER AWARD AND THE JOHN FRITZ AWARD
(An overflow crowd of more than 1200 attended the luncheon in the ballroom of the Conrad Hilton Hotel where former president Herbert Hoover was principal speaker.)

giant firms were engineers or scientists, of real technical competence. From that observation about Germany, I think we should heed a vital warning: a nation cannot survive on technological superiority alone. Those who carry industrial responsibility must also feel real responsibility for, and exercise influence on, broad national policies, in so far as they affect the common good. They cannot afford to leave it to the other fellow; to shirk their responsibilities to provide political leadership.

"I hope you will not think it immodest if I suggest that we engineers, who are taking an active part in the legislative and executive branches of governments, are taking another step forward. Just as our predecessors brought to scientific and industrial policy the benefits of their training and talent, so we are bringing to bear on the terribly involved problems of present-day government the outlook and philosophy which is the hallmark of our profession.

"The day is past when rule by a group of citizens trained in any one field can give satisfactory service to a nation in a complex world. The engineer's voice must be heard, and his presence felt, in the deliberations of national councils, for he has something unique to contribute to the understanding of present-day problems. And I would like to testify from my experience that an engineer can get elected, and is welcomed by his fellow legislators and administrators. Following many years of reasonably successful professional practice, I now find there is a special kind of satisfaction in public service which makes all the inevitable sacrifices seem unimportant."

In closing, Mr. Howe carried his theme one step further. "As I have already remarked," he said, "whether we like it or not, we can no longer live to ourselves nationally, any more than we can individually. It is supremely important to realize that, while it is comparatively easy to be friends, it is exceedingly difficult to operate as effective and contented allies. It is as partners in an alliance of freedom-loving nations that we must work and fight if we are to survive collectively. The truth of this is obvious.

"We all know that in business, in associations, in politics, whenever men come together for group action, frictions arise, incompatibilities appear, differences of interest are aggravated, a hundred-and-one adjustments are needed, that are not required in ordinary friendly social or business intercourse. . . .

"We have learned to work by compromise in local societies, in national groups, and in political parties, but it would be naive indeed to suggest that internal difficulties do not arise. What is even more naive, I think, is to be surprised when difficulties arise between allies with different national backgrounds. It is imperative that we all realize fully that it is not an easy thing to operate as allies. . . . But if we are to obtain our supreme goal, true world peace, it is of vital importance that we learn the techniques of international co-operation, just as we have mastered the techniques of national citizenship.

"In this, I suggest our two countries have succeeded to a remarkable degree, and are offering a model for international co-operation."

HERBERT HOOVER ON "THE SCIENTISTS' AND ENGINEERS' PROMISE TO AMERICAN LIFE"

When Herbert Hoover rose to deliver his address, "The Scientists' and the Engineers' Promise to American Life," he was greeted by a tremendous ovation.

"Progress in scientific discovery, invention, and their application," he declared, "will depend upon:

"1 The maintenance of a climate of individual freedom of mind, spirit, and action from which alone they can spring.

"2 To achieve that, this nation must keep out of wars, avoid inflation and unload these unbearable taxes. We might remember that ancient Athens, Rome, and some modern states by such practices bled white the intelligence and energies of their race.

"With this reservation I can say at once that the American people are on the threshold of a greater advance in living and comfort than ever known to mankind.

"The promise of the scientists and engineers of the world rests upon two foundations—the wider application of what we already know and the certainty of new discoveries and new inventions.

"Even without any additional scientific discoveries or inventions we know these things:

"The next generation will have less diseases and cure them faster than the last generation.

"They will have less germs and insects to bite them.

"They will have bigger and better food animals and plants, and less acres devoted to nonfood products. Add to this more food from the sea, and there will be an abundance for our people.

"Already known synthetic fibers will give the next generation better and cheaper clothes.

"Our new knowledge of highway, air transport, and Diesel engines and atom power will expand easier, cheaper, and safer transportation.

"Our improved industrial methods and processes and bigger laborsaving tools will be more widely used. The next generation will control their mechanical processes more and more precisely and with less labor by our already known electronic devices.

"The next generation will have wider application of our new chemical and mechanical processes for extracting metals from low-grade ores. They will have more synthetic materials and thus more abundant and cheaper construction.

"From all this we will have better and cheaper housing with all the gadgets.

"Our new knowledge of electronics gives promise of ever-widening communications by radar, radio, and TV. The next generation may need endure still more singing commercials.

"And they already know more about how to kill fellowmen than the past generation.

"Beyond all our accumulated knowledge which could be intensively applied by the next generation, we are assured of new discoveries in science and new inventions not now known. This is certain for several reasons.

"The next generation will have the advantages of already created better instruments and equipment for scientific research than the last generation.

"At the beginning of the hundred years we celebrate, there were but a few scattered laboratories in our universities and colleges over the world. Today, America has more than five thousand effective laboratories—more than all the rest of the world put together. And in a hundred of them, each staff is greater than the personnel in all of them put together a hundred years ago.

"There was a time when we got our new inventions from a poverty-impelled genius in the garret. That time has long gone by. We have discarded a bread and water diet as the mother of invention. Our greater gifts from the past century came from long years of patient laboratory research and experiment by trained workers. We now have a new era in research by the co-ordination of teams of scientists who bring to our problems the combined knowledge of physics, chemistry, mathematics, and biology.

"The result of scientific research in the future as in the past will be like the growth of plants, cell by cell. Someday there comes forth a new blossom of great scientific discovery, an illuminating hypothesis, a fruitful generalization, or a new instrument for enlarged research.

"From this increasing raw material of abstract science the engineer will bring still more inventions, still greater command of power, still new materials, and still more laborsaving devices, and new methods.

"Out of his imagination, his blueprints, his construction will spring the new additions to human service and comfort, to leisure and recreation.

"But we are even today plagued with two persistent ghosts which haunt the lay mind. The first is the fright of technological unemployment. That ghost has been summoned from its lair every year since Eli Whitney invented the cotton gin. Yet for every job in the livery stable of yesterday, there are a hundred jobs in the garage of today at four times the take-home pay. Moreover, a study of our annual flood of patents shows that two thirds of them are for production of new or better methods and articles of use and with new jobs. Further, a study of our comparative occupations over years shows that three times as many work people are recruited into new occupations as those whose jobs disappear in obsolescence.

"The other truculent ghost of space writers is that our inventions and mechanization create degenerative physical pressures upon those who work them. The contrary is true. Our engineering results are accomplished by making our machines and heads work harder—not our hands.

"And the consequences of these advances produced by the scientists and engineers have another import.

"From Watt's invention of the steam engine, down the long road of inventions to the latest electronic recorder, scientific discovery and the inventions by engineering productivity have periodically saved the world from improverishment by the wars created through lost statesmanship. That is our hope for our nation today.

"And let me add that bureaucracies do not produce these wonders in scientific discovery or invention Governments can at times advantageously subsidize research or pioneering of the application of known discoveries.

"However it is dynamic men and women, free in mind and spirit, who make these human advances. The decadence of scientific research in Germany under Hitler is a lesson to the world.

"There also lies in these fields of science and engineering a contribution to the moral and spiritual welfare of mankind. Here is the 'inculcation of veracity of thought' in a world sodden with intellectual dishonesty. For science and engineering must first be expressed in words of truth, or they do not work. And from scientists and engineers comes the harmonizing of the individual to the pattern of his environment.

"Above all they bring the confirmation of a Supreme Guidance in the universe far above man himself."

CENTENNIAL EVENING PARTY

The largest public meeting of the Centennial celebration was held at the International Amphitheatre, scene of the recent Republican and Democratic national conventions. The plan

called for a dinner to be held in the second-story wings of the Amphitheatre where arrangements had been made for the 2200 persons present to hear Charles F. Kettering speak on "A Review of the Century." A series of unfortunate events caused a switch of the address to the Amphitheatre itself where the confusion and noise was so great that most of Mr. Kettering's message was not heard by the audience. Carlton S. Proctor introduced Mr. Kettering. After the address had been delivered, a special performance of "The Sonja Henie 1952 Ice Review" was staged.

THE SYMPOSIUM PROGRAM

Early in the planning stages of the Centennial certain specific aims were announced: "to dramatize effectively for the public the principles which have produced the leading nation of the world and to point the way to further development; to acquaint the public with the part played in this development by the engineering profession and progressive management; and to attract qualified young men to study engineering to fill the future's great need for technically trained men in industry." A program of public lectures, known as the symposium program, was developed as one means of attracting the general public to the Centennial. It was intended that the symposium papers would be "presented in sufficiently nontechnical terms to be readily understandable by the average layman and at the same time to be of specific value to engineers." It was further intended that "each subject should be developed with appreciation of its social and economic implications and of its dramatic appeal" and that each program should "cover a brief historical review, a discussion of present-day problems, and a look into the future."

The symposium program was divided into twelve categories. A chairman was appointed to be responsible for each category and to solicit the papers to cover the subject under his jurisdiction. In order to provide ample seating capacity for audiences not only of engineers but of the general public, the Eighth Street Theater was engaged; and, where more than one portion of the program was scheduled for a given period, other large meeting rooms in hotels were set aside.

The twelve categories of subjects covered by the symposium program and the names of the chairmen responsible for each are as follows:

I The Role of the Organized Profession, Harry S. Rogers, president, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

II Education and Training, A. A. Potter, dean of engineering, Purdue University, Lafayette, Ind.

III Food, Clarence Francis, chairman, General Foods Corporation, New York, N. Y.

IV Tools, Kenneth H. Condit, dean, School of Engineering, Princeton University, Princeton, N. J.; vice-chairman, H. L. Tigges, executive vice-president, Baker Brothers, Inc., Toledo, Ohio.

V Transportation, Charles F. Kettering, research consultant, General Motors Corporation, Detroit, Mich.

VI Mineral Industries, Clyde Williams, director, Battelle Memorial Institute, Columbus, Ohio.

VII Structures and Construction, Waldo G. Bowman, editor, *Engineering News-Record*, McGraw-Hill Publishing Co., New York, N. Y.

VIII Chemical Industries, Francis J. Curtis, vice-president, Monsanto Chemical Company, Washington, D. C.

IX Communications, William H. Harrison, president, International Telephone and Telegraph Corporation, New York, N. Y.; vice-chairman, L. A. Du Bridge, president, California Institute of Technology, Pasadena, Calif.

X Energy, Eugene Ayres, technical assistant to executive vice-president, Gulf Research and Development Company, Pittsburgh, Pa.

XI Health and Human Engineering, Thomas Parran, dean, Graduate School of Public Health, University of Pittsburgh, Pittsburgh, Pa.

XII Urbanization, Harland Bartholomew, Harland Bartholomew Associates, St. Louis, Mo.

During the course of the symposium program nearly ninety papers were presented. The list of authors included some of the best authorities that the nation afforded. A tremendous amount of valuable material was contained in these papers. As will be seen by a glance at the list of major subjects, the most important phases of mankind's material well-being were covered. Unfortunately, the great number of competing events provided by the technical programs of more than sixty engineering and related organizations which were holding meetings of their own during the Centennial prevented full attendance at the Symposium program. Attendance was disappointingly small in most cases, and there was little evidence that the nonengineering public had seized the opportunity offered to listen to the expositions by the eminent speakers. Plans are under way to publish the papers which constituted the symposium program.

MORE THAN 60 ENGINEERING ORGANIZATIONS HOLD INDIVIDUAL MEETINGS

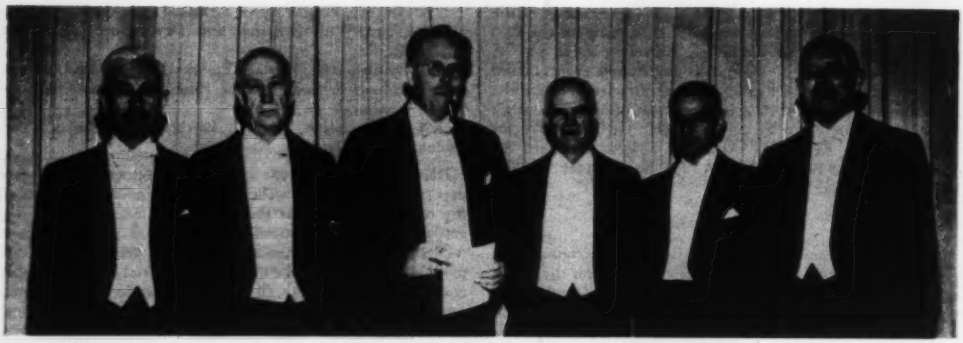
Up to this point this report on the Centennial of Engineering has been principally concerned with the portions of the celebration that were the responsibility of the corporation, Centennial of Engineering, 1952, Inc., with only incidental mention of the other events, such as the meetings of the more than sixty engineering societies and related organizations which took place during the period of September 3 to 13. When the Centennial was planned, the American Society of Civil Engineers, wishing to broaden its scope and significance, suggested to the other societies which constitute Engineers Joint Council that they schedule meetings in Chicago during the first two weeks of September. Prompt acceptance of the suggestion led other societies and organizations to join in a co-ordinated enterprise of interest to the entire engineering profession. Howard F. Peckworth, managing director, American Concrete Pipe Association, accepted chairmanship of a committee to co-ordinate general arrangements, and G. Donald Kennedy, assistant to the president, Portland Cement Association, headed a committee to co-ordinate technical programs. Each society assumed responsibility for arranging and financing its individual program, but all programs were printed in the 364-page "Convocation Program."

1952 ASME FALL MEETING

The American Society of Mechanical Engineers, with its Chicago Section as host, scheduled its 1952 Fall Meeting at Chicago. With the attractions of the Centennial as a drawing card, the ASME Fall Meeting offered a larger program than normal and registered an unusually large attendance, about 1200 persons. A brief report on the 1952 ASME Fall Meeting, which ran from September 7 through September 11, appears in the News Section of this number of MECHANICAL ENGINEERING.

ECPD ANNUAL MEETING

Likewise the Engineers' Council for Professional Development, which normally holds its two-day annual meeting at the end of October, shifted that event to September 4 and 5 in order to become a part of the Centennial. Part of its program was merged with that of one of its constituent bodies,



DISTINGUISHED ENGINEERS WHO WERE INDUCTED AS HONORARY MEMBERS OF ASCE AT THE CENTENNIAL OF ENGINEERING

(*Left to right:* André Coyne of France; E. G. Bailey, past-president ASME; Carlton S. Proctor, president ASCE, who conferred the certificates of honorary membership; Chalmers Jack Mackenzie of Canada; Ary Frederico Torres of Brazil; and Harvey S. Mudd, past-president AIME.)

The American Society for Engineering Education. A brief report of the ECPD annual meeting will be found in the ASME News Section of this number of MECHANICAL ENGINEERING.

EIC RECEPTION

Although it held no technical sessions at Chicago, The Engineering Institute of Canada was well represented at the Centennial by several of its present and past officers. On Friday, September 5, EIC staged a delightful reception at the Conrad Hilton Hotel for its members resident in the United States, for Canadian Centennial registrants, and for senior officers of sister societies of the Institute. A considerable number of South American UPADI delegates were also present.

ASCE HONORS DINNER

One of the most delightful events of the entire Centennial program was the Honors Dinner of the American Society of Civil Engineers which took place in the Grand Ballroom of the Conrad Hilton Hotel on Saturday evening, September 6. Cocktails were served prior to the dinner and an opportunity was afforded the guests of viewing the many official congratulatory greetings, most of them beautifully illuminated and engrossed, which had been sent to ASCE in honor of their one-hundredth anniversary. They were displayed in the antechamber of the ballroom. A reception was held immediately following the dinner.

Two "head tables" had been provided. At the high table sat the president of ASCE, those who took part in the honorary membership ceremonies, and their wives, and the guest speaker. At the lower table sat a number of officers of national engineering societies and their wives.

The ceremony of bestowing honorary memberships was marked by a dignity befitting the occasion yet surcharged with a warmth of friendliness and human interest that commanded the admiration and sympathetic response of all members of the audience. Citations were read by Gail A. Hathaway, past-president ASCE, and the certificates of honorary membership were conferred by Carlton S. Proctor, president, ASCE. This truly remarkable team performed what is sometimes a stiff and perfunctory task with a charm, decorous vivacity, and good taste such as is seldom witnessed in these ceremonies. Both Mr. Proctor and Mr. Hathaway had excellent voices and clear diction and the citations prepared and read by Mr. Hathaway were of high quality and happily phrased. The responses by the recipients afforded the guests an excellent opportunity to see and assess the qualities of these distinguished engineers.

The five engineers who received certificates of honorary membership in ASCE were: E. G. Bailey, of New York; André Coyne, of France; Chalmers Jack Mackenzie, of Canada; Ary Frederico Torres, of Brazil, and Harvey Seeley Mudd, of California.

E. G. Bailey, past-president ASME and recipient of many honors in the United States and overseas including the John Fritz Medal, inventor and engineer, president of the Bailey Meter Company, and director, Babcock & Wilcox Company, needs no introduction to readers of MECHANICAL ENGINEERING.

André Coyne, outstanding designer and builder of dams, is a consulting engineer of Paris, France, and is noted for his achievements in the fields of port and maritime structures and bridges. He has built more than 50 dams, including Europe's tallest dam now being built in the Alps. A former head of the French Technical Service for Large Dams and inspector general of bridges and roads, he has, since 1946, been president of the French National Committee and of the International Commission on Large Dams, presiding over the international meetings held in Stockholm in 1948 and in New Delhi in 1951.

Chalmers Jack Mackenzie, a former professor of civil engineering and dean of engineering at the University of Saskatchewan, was overseas with the Canadian Expeditionary Forces in World War I and was awarded the Military Cross. In 1935 he was appointed to the Advisory Council of the National Research Council (Canada) and became acting president in 1939. Since 1944 he has been president of the Council and director of industrial research and development in the National Department of Reconstruction. At present he is president of Atomic Energy of Canada, Ltd. He is a past-president of The Engineering Institute of Canada and recipient of many honors.

Ary Frederico Torres, of Sao Paulo, Brazil, civil engineer and authority on cement and other construction materials, is Brazilian Ambassador to the United States Point Four Program, president of the National Economic Development Bank of Brazil, and professor of materials of construction at the University of Sao Paulo. From 1926 to 1939, Dr. Torres served as director of the largest industrial research organization in South America and in 1937 as Secretary of Highways and Public Works for the state of Sao Paulo. His engineering career has been marked with many other important posts and the writing of technical papers and texts.

HONORARY MEMBERSHIP IN ASCE IS CONFERRED ON E. G. BAILEY, PAST-PRESIDENT ASME, AT CENTENNIAL OF ENGINEERING

(*Left to right*): Mrs. Carlton S. Proctor, Mr. Proctor, president ASCE, Mr. Bailey, Gail A. Hathaway, past-president ASCE, reading the citation, and Mrs. Bailey.)

Harvey Seeley Mudd, mining engineer and past-president, American Institute of Mining and Metallurgical Engineers, is well known for his professional and civic activities. Mr. Mudd's principal professional activity has been the development and management of copper mines on the Island of Cyprus. With other members of his family Mr. Mudd established in 1929 the Seeley W. Mudd Memorial Fund, the income of which is used by AIME for researches, publications, or other projects that will advance the science and art of mining and metallurgy. His civic interests and services include presidency of the Southern California Symphony Association, membership on the Board of Governors of the Los Angeles Museum of History, Science, and Art and the Southwest Museum, and trustee of the California Institute of Technology. In 1936 he received the award of the City of Los Angeles as the citizen contributing the "most valuable and unselfish service to the community."

EJC ENGINEERING MANPOWER COMMISSION

One of the most successful events of the Centennial from the point of view of attendance and interest displayed by the audience was the program on Sunday, September 7, on Manpower Utilization and National Security, sponsored by the Engineering Manpower Commission of Engineers Joint Council with the co-operation of the Western Society of Engineers. The general chairman was O. W. Eschbach, president, Western Society of Engineers, member, Engineering Manpower Commission, and dean, Northwestern Technological Institute, Northwestern University, Evanston, Ill. The program consisted of a morning session, a luncheon, and an open forum conducted in the afternoon. About 600 persons attended the sessions which were held in the Grand Ballroom of the Conrad Hilton Hotel.

At the morning session, Carey H. Brown, chairman, Engineering Manpower Commission of Engineers Joint Council, read a carefully prepared statement "Manpower Utilization and National Security," which highlighted the position of the Commission with respect to such important manpower problems as national manpower mobilization policy, universal military training, universal military service, ROTC, Armed Forces Reserve, Selective Service, and utilization of persons having specialized and critical skills. In the course of his presentation Mr. Brown made thirteen specific recommendations in the interest of national security. The text of the address will be found on pages 892–896 of this issue of MECHANICAL ENGINEERING.

After Mr. Brown had completed his address, prepared discussions were presented by a group of persons who expressed a variety of views. These discussers were: Arthur S. Adams, president, American Council on Education; William C. Foster, Deputy Secretary of Defense (Mr. Foster's discussion was read by John D. Braymer); George A. Jacoby, director of personnel services, General Motors Corporation; Gen. Lewis B. Hershey, Director of Selective Service (presented by Col. D. Joel Griffing); Harry S. Rogers, chairman, ECPD; and J. E. Trainer, director and vice-president, Firestone Tire and Rubber Company.

After luncheon, Henry J. Taylor, economist, journalist, and radio commentator, added his observations to those presented by the discussers at the morning session and members of the group, with the addition of S. C. Hollister, of Cornell, M. H. Trytten, National Research Council, and Gen. C. S. Dargusch (counsel) of Columbus, Ohio, answered questions which were asked by members of the audience. The entire proceedings of the session were summarized by A. C. Monteith, vice-president, Westinghouse Electric Corporation. It was announced that the proceedings would be available as soon as they could be reproduced.

TECHNICAL PROGRAMS

At least half of the engineering societies and related organizations which participated in the Centennial conducted sessions for the presentation of technical papers in addition to business, luncheon, dinner, and other general events. The most extensive of these independent programs was that of the American Society of Civil Engineers. The other EJC societies, AIME, ASME, AIEE, and AIChE also provided programs of technical sessions which covered periods varying from three to five days. No attempt will be made in this report to cover the programs of these or other societies. It has been reported that the program

and the attendance of sessions conducted by ASCE were the largest of its long history.

SOCIETY OF WOMEN ENGINEERS

This report would be incomplete, however, if it did not mention the convention of the Society of Women Engineers which was held during the Centennial and was a part of it. This was truly an historic convention inasmuch as it was the first time that this young and active society had taken part in a nation-wide assembly of engineers. All events of the Society of Women Engineers' program took place in the quarters of the Western Society of Engineers on Friday, September 5.

At the morning session Lillian G. Murad, president, Society of Women Engineers, and vice-president, Murad Textile Print Works, Inc., New York, N. Y., delivered an address of welcome to the members and guests. Mary L. Murphy, engineer, Illinois Bell Telephone Company, Chicago, Ill., presided at the luncheon. A dinner, preceded by a reception, was held Friday evening. Dot Merrill, chief engineer, Merrill and Company, chairman, Chicago Section, and member of the board of directors, Society of Women Engineers, served as chairman, and introduced Lillian G. Murad, president, SWE, Ovid W. Eschbach, president, Western Society of Engineers, and dean, Northwestern Technological Institute, Northwestern University, and the speaker, Dr. Lillian M. Gilbreth, president, Gilbreth, Inc., Montclair, N. J., whose subject was, "Some Problems That Challenge Engineers Today."

Emma C. Barth, engineer, Westinghouse Electric Corporation, East Pittsburgh, Pa., presided at the technical session on Friday morning. The speakers were Elsie Eaves, business editor, *Engineering News-Record*, New York, N. Y.; Marie Reith, tax analyst, Consolidated Edison Company of New York, Inc., New York, N. Y.; and Katherine Stinson, chief, specifications staff, Aircraft Engineering Division, CAA, Washington, D. C.

At the afternoon technical session Mary Louise Pottle, sales engineer, Allis Chalmers Manufacturing Company, Boston, Mass., presided. The speakers were: Elizabeth M. G. MacGill, consulting engineer, Toronto, Ont., Canada; Prof. Mary P. Blade, The Cooper Union, New York, N. Y.; and Evelyn Jetter, electronics engineer, Atomic Energy Commission, New York, N. Y.

THE CHICAGO ENGINEERS

No matter how skillfully planned and ably administered such great events as the Centennial of Engineering are, they owe a large measure of the success they attain to loyal individuals and groups which make the convention city their home. Tribute must be paid to the Western Society of Engineers, its president, Ovid Eschbach, its executive secretary, J. Earl Harrington, and its staff and members, and to the local sections of the national engineering societies in Chicago. In this Journal mention must be made of the Chicago Section of The American Society of Mechanical Engineers for all that its members did, individually and as a group, to make successful not only the Centennial, but, more particularly, the 1952 ASME Fall Meeting. Gracious and generous hosts, they labored long and well to provide their guests with appropriate and delightful social entertainment and they greatly eased the burdens of the Society committees and staff members on whom fell the responsibility of conducting the technical sessions.

CONCLUSION

The 1952 Centennial of Engineering has passed into history. He would be an obtuse and unimaginative person indeed who did not find in it a significance, which, if it cannot be fully expressed in words, is none the less real. Each person who was privileged to witness and become part of the great celebration will place his own interpretations and values on it, but he will long remember it. And for the engineering profession, a new century of engineering has begun.

To this observer, who saw quite as much behind the scenes as he did as a spectator before the footlights, memory is rich in the personalities involved in the planning and execution of the Centennial. To all these nameless ones he pays tribute, and to one in particular, a special tribute. Carlton S. Proctor, president, American Society of Civil Engineers, did a superlative job. On him as on no other man demands were made for public appearance. On these occasions he personified before the world the engineering profession of the United States. Not only members of his own society but all engineers are deeply in his debt and have reason to be justly proud of him and grateful to him for the manner in which he conducted his numerous and varied assignments.—G. A. S.

Crash Injury Research

ABSENCE of injury in the Hi-G deceleration tests at Muroc, and limited body damage in many severe airplane crashes suggest that injuries are not a direct function of crash force, according to a report prepared by the Crash Injury Research Project, working under an Office of Naval Research Contract at Cornell University Medical College, New York, N. Y. The report analyzes injuries sustained by 800 survivors of light plane crashes; each of the survivors used only a safety belt as a restraining and protective means in crashes.

Five analytical procedures are followed to provide basic material from which to draw conclusions: (1) a segment of current data is compared with data from an early CIR report to determine whether early trends now are statistically confirmable; (2) the site and frequency of injuries are examined in order to determine the relative constancy and variability of the injury pattern produced by survivable aircraft accidents; (3) the frequency characteristics of the injury pattern are investigated and interpreted; (4) dangerous-to-life injuries are examined and discussed; (5) the degree of correlation between injury seriousness and accident severity is established.

Statistical analyses show that (1) the trends demonstrated in early CIR data are confirmed; a low incidence of strains of the neck and damage of cervical vertebrae, and a high frequency of damage to the head and extremities is established; (2) there is a distinct and constant pattern of injury among survivors of light plane crashes who wear only safety belts; (3) a positive relationship exists between the frequency of injuries and the distance of damaged body areas from the safety belt; bruises of the hips and evidence of intra-abdominal injury are surprisingly rare, despite violent snubbing action by standard 2-in. safety belts with holding capacities of 1000 to 2000 lb; injury to one body area usually is not dependent on the occurrence of injury in another body area; (4) dangerous head injuries are sustained by nearly 18 per cent of survivors; spinal injuries are likely to endanger life far more frequently than lower torso injuries; (5) of all the variance in seriousness of injury, only 22 per cent of this variance is dependent upon variation in accident severity.

The statistical evidence provided in this report shows that injuries are not a direct function of crash force; the data indicate that injuries in survivable accidents are largely subject to control by engineering and design.

Stronger Engineering Graduates

By GILBERT E. DOAN

RESEARCH DEPARTMENT, KOPPERS COMPANY, INC., PITTSBURGH, PA.[1]

IT is well recognized that after the four-year round of courses with specialists at college whatever life philosophy the student may have brought from his home has lost its unity. The resulting disunity of thinking leads to disunity and confusion of spirit. This confusion results in weak and uncertain graduates where strong and adaptable leaders are needed. His ideals and convictions *should* be shaken basically by the specialists. But before he leaves college some aid should be given him to re-form at least a tentative life philosophy based on reason and justice. Most men should leave our colleges with a clear and worthy view of life.

The German professors were the world's best specialists, but they turned a deaf ear to the student's professional, civic, social, and ethical problems. As a result, these students, denied guidance by their natural leaders, followed eagerly a man who offered them definite answers and positive guidance. His name was Hitler and he led his country to ruin.

Specialization and research must remain and grow both in science and in the humanities. But we must also turn out consciously integrated graduates dedicated to a life of justice, reason, mercy, and truth. This is our heritage from the English universities. This integration should be the culminating phase of a man's education. It is the creative answer to subversion of all kinds.

A SOLUTION

The first step necessary for most students is to bring their scattered and fragmentary "courses" of study together into a focus. The student's own problems provide a suitable focus—war, communism, the welfare state, and labor. With just a little encouragement he can see the need for working out a rational life view to face the world intelligently. The specialists who have taught him the individual courses pay little or no attention to this need.

We have provided good intellectual fare in science and the humanities, taught by competent specialists. Then we have turned our attention to extracurricular activities including athletic and social life, hoping the boy would make his own synthesis. Thus, the final step of the intellectual program has been omitted. We have overlooked the influence of the Oxford tutorial in aiding young men to evolve a rational life view.

This synthesis must be encouraged in small discussion groups, or in individual tutorial hours as has been the practice at Oxford for so many years. Indoctrination, of course, must be despised as abuse of students and ultimately ineffective anyway. A friendly atmosphere must prevail. Opposing viewpoints must be represented clearly. The students must be permitted to choose the topics of discussion, and the world must be looked at through their eyes. Of course, no teacher feels that he is fully competent to meet this demand (neither are the Oxford dons) but we must satisfy this hunger in students for a rational outlook with what we have to give them and not send them away empty simply because we are not "experts" in the field.

RESULTS OF AN EXPERIMENT

After conducting a discussion of this kind once a week with a group of seniors in metallurgical engineering who elected this course last year, I have read their term papers. The papers showed the following features:

1 Each student is consciously constructing his own philosophy which he knows will change as he matures.

2 The philosophies are rudimentary and even shallow in spots, but a vision has been caught of what a rational life view means.

3 Not a single man felt he had been subjected to indoctrination but rather that he had been warned against it. Considerable diversity of views prevailed on any given topic.

4 Religion enters these philosophies only as a general background and in most of the papers is not mentioned.

5 A sense of social responsibility has been accepted as justified. (This alone might justify the course.)

6 The eight students who elected the course are enthusiastic about it. All have elected the sequel for the next semester. Several remarked that this course should be required, not only for all engineering students but for all college students.

7 Several books by broad thinkers have been read by each man from the list: Eddington's "Nature of the Physical World," Sinnott's "Cell and Psyche," Lynd's "Middletown," Lilienthal's "This I Do Believe," Montagu's "On Being Human," Polanyi's "Science, Faith, and Society"; articles such as those on labor in *Fortune Magazine* and others have been read and discussed, thus opening new doors for the student.

8 The material learned in other courses such as science, economics, government, history, politics, international relations, philosophy, and biology have been related to the outlook of an engineer as he enters his profession in society, or at least he has seen in numerous instances that these fragments of knowledge *can* be related in one man's mind and should be related in his own.

9 Specific positions (admittedly temporary) have been taken with respect to the student's problems; the welfare state, private enterprise, communism, war, career ambitions, labor, and personal responsibility.

10 Highly developed technical philosophies have not been stated by the students nor taught; but each man has caught a vision of a rational outlook to which the fragments of life and learning can be related. One student remarks that most people never seem to reach a rational philosophy in an entire lifetime, and he is glad that he has at least made a start.

11 These students have become personally acquainted with the solutions, attitudes, and interests of at least one of their teachers, and one who has taken the trouble to show them clearly the directly opposite view to his own, thus breaking down at one point at least the barrier erected by the mass-production system of education between professor and student, as well as the barrier between youth and maturity.

12 The students feel strongly that the conferences should begin earlier than the senior year.

Next semester there will be guest leaders of the discussions—eminent men in politics, science, labor, and management of industry, thus bridging the gap between campus and com-

(*Continued on page 908*)

[1] At the time this paper was written the author was professor of Metallurgy at Lehigh University, Bethlehem, Pa.

Modern HIGH-PRESSURE HIGH-TEMPERATURE BOILERS

2 *Present Trends and Considerations in Steam-Temperature Controls—Reheat Boilers*

By GEORGE W. KESSLER

THE BABCOCK & WILCOX COMPANY, NEW YORK, N. Y. MEMBER ASME

ALTHOUGH there are many ways in which both superheat and reheat may be controlled over a wide range, the present trend, as indicated by units recently placed in service, units building, and design proposals, is toward the use of gas recirculation or burner positioning in conjunction with spray attemperators or gas by-pass.

There are several reasons for this well-defined trend. With either gas recirculation or burner positioning both superheater- and reheater-surface requirements are reduced since they can be sized to obtain the required temperatures at the top load. Further, with either of these two methods the gas temperature leaving the furnace at full load usually is much lower than that required when attemperators only are provided to cover the same control range. These methods also allow greater latitude in the disposition of heating surfaces as well as the adjustment of surfaces with respect to selected optimum furnace exit-gas temperatures. This is not always possible with some other methods of control unless restricted control range is acceptable.

Economically, both gas recirculation and burner positioning have much to offer. Because surface requirements are minimized, the over-all cost, steam pressure drop, draft loss, and the space occupied are reduced.

When these methods are used in conjunction with attemperation the maximum attemperation occurs at some partial load in the control range, and, if surfaces are disposed properly, only in the superheater. This, in general, reduces alloy requirements and is consequently reflected in the cost of the unit.

GAS RECIRCULATION—SERIES AND PARALLEL FLOW ARRANGEMENTS

When using gas recirculation or burner, positioning with attemperators for the control of reheat-boiler units, the so-called "series arrangement" of surfaces can be used. In these designs the reheater is located between the primary and secondary superheaters, and the products of combustion from the furnace pass across the secondary superheater, the reheater, and then the primary superheater in their path toward the boiler exit, Fig. 16. This arrangement can be designed so that it should not be necessary to use attemperation in the reheater at any load. However, because it is not always possible, in any design arrangement, to establish the exact superheater and reheater surfaces, and because of variations in fuel and the effectiveness of furnace heat-absorbing surfaces, attemperators often are installed at the inlet to the reheater. Then, if the reheater absorbs too much heat, the required exit steam temperature can be maintained by spraying the steam prior to the reheater inlet.

Presented by the Power Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS at a meeting of the Philadelphia Section, Philadelphia, Pa., April 24, 1952. For Part 1 see MECHANICAL ENGINEERING, October, 1952, pp. 797–802.

There are some who place considerable emphasis on minimizing the quantities of spray water used in both superheaters and reheaters. Consequently, many of the recent reheat-boiler designs using gas recirculation incorporate a "parallel flow" arrangement which combines the best features of gas recirculation, spray attemperation, and gas proportioning. In this arrangement it is customary for the products of combustion, after leaving the furnace, to pass across the secondary superheater. The gas is then divided into parallel flow streams which pass across the reheater and the primary superheater. The primary superheater and the reheater are separated by division walls, and the dampers located at the outlets of the respective passes establish the proportions of the gas flows, Fig. 17.

The gas-proportioning dampers may be used for temperature control or for readjustment. When they are used for control the percentage of gas flowing across the superheater can be reduced as load is decreased, and this provides the required greater proportion of heat to the reheater. By correlating gas recirculation properly with damper proportioning of gas flow it is possible to obtain the required superheat and reheat temperatures over the control range without attemperation, and with a reduction in the quantity of gas recirculated as compared to that required with the series arrangement.

STEAM-TEMPERATURE ADJUSTMENTS—GAS-PROPORTIONING DAMPERS

Gas-proportioning dampers also offer very effective means of adjustment. Thus a change in feedwater temperature, occasioned perhaps by the loss of a high-pressure heater, should not necessitate spraying the reheat steam since the proportioning dampers can direct a larger percentage of the gas flow across the superheater. Variations in fuels, furnace exit-gas temperatures and excess air, as well as possible inaccuracies in the proportions of the reheater and superheater surfaces also can be adjusted by the use of gas-proportioning dampers.

However, there may be occasions when the variations in some of these factors will be far greater than those originally contemplated, and therefore, many installations incorporate spray attemperators for use with both the superheater and reheater, or provide for their future installation.

STEAM-TEMPERATURE ADJUSTMENTS—FURNACE-WALL BLOWERS

Similarly, because of variations in fuel, or types of fuels, the use of furnace-wall blowers should be considered as an aid in the maintenance of furnace heat-absorption effectiveness and the adjustment of steam temperatures. Even with limited variations in fuel, furnace-wall blowers are quite effective, particularly if the fuels are such that wall slagging may occur.

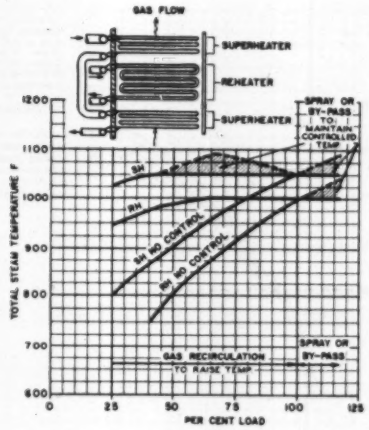


FIG. 16 CONTROL OF SUPERHEAT AND REHEAT TEMPERATURES—SERIES ARRANGEMENT

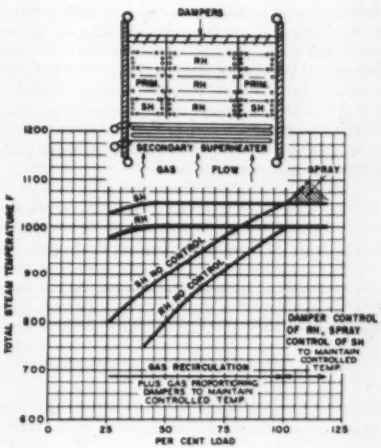


FIG. 17 CONTROL OF SUPERHEAT AND REHEAT TEMPERATURES—PARALLEL ARRANGEMENT

Their importance, as a means of temperature adjustment, increases as the limits of the other controls are reached.

MANUAL, SEMIAUTOMATIC, AND AUTOMATIC TEMPERATURE CONTROL

With all of the various designs for the control and adjustment of steam temperatures serious consideration also must be given to the use of manual, semiautomatic, and fully automatic controls. Generally, in an effort toward simplification, only the basic means of control are adapted to automatic regulation. This is relatively easy in nonreheat units since only one basic method of control is required, and the adjustments offered by such features as spaced burners and wall blowers can be operated manually from the control panels.

However, in reheat units there is usually more than one basic method of temperature control and in some designs as many as three methods are combined to obtain the most desirable operating features. It is customary in the two prevalent types of reheat boilers utilizing the series arrangement of surfaces to automatically regulate gas recirculation and attemperation, or burner positioning, and attemperation. In these designs, gas recirculation, or burner positioning, is generally used as the basic method for the control of the reheat-steam temperature. Other means of adjustment, such as burner spacing and furnace-wall blowers, are operated manually.

The advantages offered by using a parallel flow arrangement with gas recirculation can be obtained with no change in the automatic controls if the proportioning dampers are operated manually. With such semiautomatic control it would be necessary, as load is decreased, to use some attemperation in the superheater until the proportioning dampers were adjusted manually to decrease the gas flow across the superheater.

If, however, a fully automatic control system is used, all three methods of control—gas recirculation, spray attemperation and proportioning dampers—can be regulated automatically. With this fully automatic control system, gas recirculation often is used to control the superheat instead of the reheat temperature, particularly if overloads are contemplated and the elimination of spray in the reheater is desired.

RADIANT-CONVECTION SUPERHEATERS

In all boiler designs the maximum allowable furnace exit-gas temperature is limited by the characteristics of the fuel. Consequently, as superheat and reheat temperatures increase it becomes more difficult to provide sufficient heat for absorption

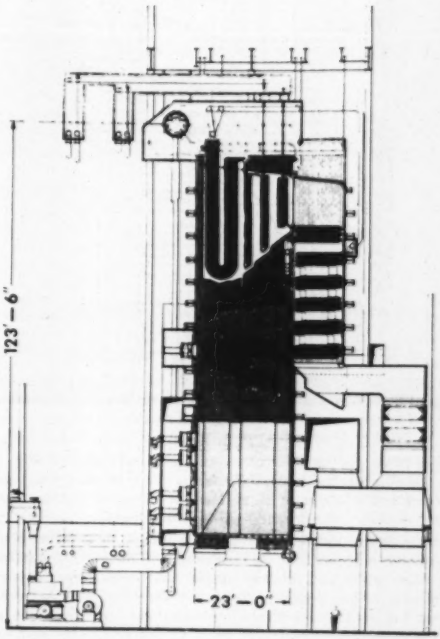


FIG. 18 RADIANT BOILER FOR 1,225,000 LB CONTINUOUS STEAM-OUTPUT WITH RADIANT-CONVECTION SUPERHEATER
(2700 psi design pressure, 1100 primary and 1050 F reheat-steam temperatures.)

in the superheater and reheater—even though they are sized to provide the required steam temperatures, without spray attemperation, at full load. Because of this partial restriction some of the recent reheat-boiler designs have used radiant heat-absorbing surface as shown in Fig. 18, for a portion of the superheater in order to obtain the necessary heat absorption. In these designs the radiant surface has been arranged in furnace platens to facilitate heat input to both sides of the tubes, and thus reduce thermal stresses.

It is apparent that as steam temperatures increase, and maximum furnace exit-gas temperatures are limited to maintain satisfactory furnace conditions, means must be found to provide the necessary heat for superheat and reheat absorption. Radiant surface can provide for part of the additional heat absorption required; however, size and alloy requirements may affect adversely the economics of these combination radiant-convection superheaters.

ADVANTAGES OF GAS RECIRCULATION AS STEAM TEMPERATURES INCREASE

It is in these high-temperature installations that the many advantages of gas recirculation become more pronounced,

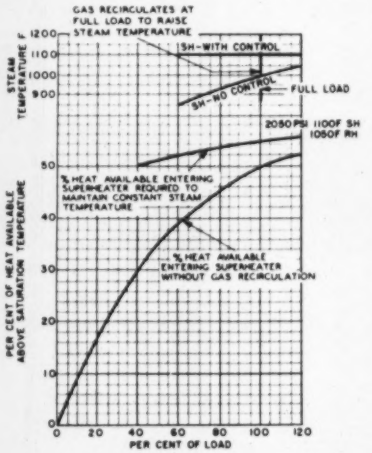


FIG. 19 USE OF GAS RECIRCULATION TO OBTAIN STEAM TEMPERATURE AT FULL LOAD

since it also is possible to recirculate gas at full load, Fig. 19. When this method is used it has the effect of sizing the superheater and reheater at some load in excess of full load and, consequently, the furnace exit-gas temperature at full load can be maintained at a lower level. Also, in another design variation it is possible, by installing a slightly greater amount of superheater and reheater surface and by selecting properly the zone of gas injection, to retain the heat potential corresponding to high furnace temperature and yet restrict the gas temperature leaving the furnace to a value consistent with that necessary for satisfactory operation, as shown in Fig. 20.

FUTURE REHEAT-DESIGNS CONSIDERATIONS—STAGE REHEATING WITH GAS RECIRCULATION

This variant of gas recirculation soon may come into prominence, particularly if fuel costs continue to increase and superheat and reheat temperatures are limited by available materials. Under these circumstances it would be imperative

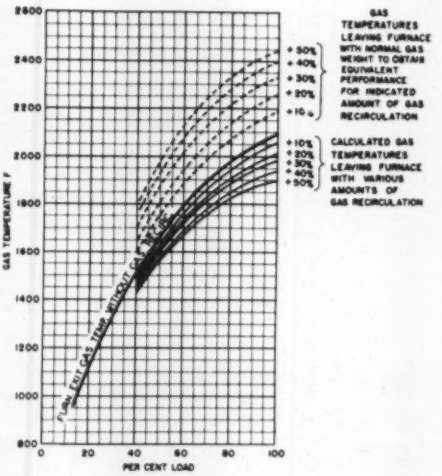


FIG. 20 VARIATIONS IN FURNACE EXIT-GAS TEMPERATURES FOR EQUIVALENT HEATING EFFECTS

to improve the plant efficiency without increasing steam temperatures, and a study of Rankine-cycle efficiencies shows that this could be done by increasing the number of reheat stages.

However, with two- or three-stage reheating the heat absorption in the superheaters and reheaters will be more than 50 per cent of the total heat absorbed in the boiler unit. Thus, since the temperatures of the products of combustion leaving the superheater and/or reheater are usually 75 deg F or more above the steam temperatures in these zones (in order to keep surface requirements within economical limits), it is apparent that furnace exit-gas temperatures must be increased to provide the necessary heat potential to the superheater and reheater, unless some means, such as gas recirculation, provides the same required heat in a greater quantity of gas at a lower temperature.

This same design variant of gas recirculation also can be utilized to great advantage when the quality of the fuel and its slagging characteristics impose limitations upon furnace exit-gas temperatures.

FUTURE REHEAT-DESIGN CONSIDERATIONS—INDIRECT REHEATERS

Recently, because of the trend toward higher steam temperatures and the possibility of stage reheating, considerable thought has been given to the use of secondary media for reheating. In these design conjectures, one of which is shown diagrammatically in Fig. 21, heat is transferred, by radiation or convection, to liquid metals or molten salts flowing through surfaces disposed in the furnace or in the zones ordinarily occupied by gas reheaters. The heat absorbed by the liquid media is then transferred in heat exchangers, located near the turbine, to the reheat steam.

There are many possible advantages in such designs. The temperature gradients across the liquid-metal or molten-salt films are far less than those in steam films, and, consequently, tube-metal temperatures can be reduced. The use of liquid metals with high heat conductances enhances the possibility of placing the heat-absorbing surface in the furnace without many of the objections which arise in connection with radiant-steam reheaters. The amount of reheat-steam piping can be

reduced greatly, since the heat exchangers would be placed adjacent to the turbine. This would be of still greater advantage if two or three stages of reheating were contemplated. Another advantage results from the fact that the secondary fluid system can be designed for relatively low pressure.

However, in all of these conjectures there also are several

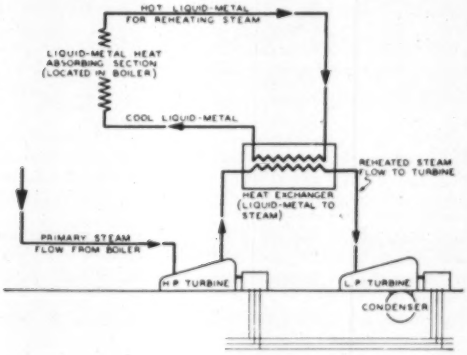

HOT LIQUID-METAL FOR REHEATING STEAM
LIQUID-METAL HEAT ABSORBING SECTION (LOCATED IN BOILER)
COOL LIQUID-METAL
REHEATED STEAM FLOW TO TURBINE
HEAT EXCHANGER (LIQUID-METAL TO STEAM)
PRIMARY STEAM FLOW FROM BOILER
H P TURBINE
L P TURBINE
CONDENSER

FIG. 21 SCHEMATIC ARRANGEMENT OF INDIRECT REHEATER

serious disadvantages. Two sets of heat-absorbing surfaces must be used, one in the boiler and one in the heat exchanger. Further, in order to keep surface requirements within economical limits satisfactory temperature differentials must be established in both sets of heating surfaces. Because of this, reheat-steam temperatures would be less than those normally obtained from a reheat boiler, if the heat-absorbing section of the indirect reheater system was installed in a gas-temperature zone similar to that utilized by the gas-type reheater. Therefore in such systems it would be necessary to install the heat-absorbing section in a zone having higher gas temperatures than ordinarily used; and, since the liquid metal must be at a higher temperature than the desired steam temperature, the containing metals must have higher resistance to oxidation than those used in steam reheaters. Further, high-grade alloys may be needed if the liquid metals are corrosive.

Pump power requirements also would be high because most liquid metals have low specific heats and consequently large quantities would have to be used to transfer the heat.

Probably the greatest deterrent to the use of indirect heaters at the present time is the fact that safe handling, piping, and transferring of liquid metals have not been developed to the point where their use is commercially feasible.

TREND TO GREATER CAPACITIES—EFFECT ON FURNACE DESIGN

The trend toward reheat has been paralleled by the trends to greater unit capacities and high steam pressures and temperatures. Consequently it has been possible to study these trends simultaneously and to consider and develop designs which incorporate the best over-all functional, operational, and economical compromises.

Studies of this type have led to the development and extensive use of furnace division walls; and have resulted in more economical units, considerable reduction in space requirements, and most important of all, improvements in functional design and operation.

In any boiler unit the heat-absorbing surfaces are disposed about the boundaries of the furnace to reduce the temperature of the products of combustion to a value consistent with good engineering and specific design requirements. Generally, for a given fuel and method of firing, this design temperature does not vary appreciably with capacity requirements and, therefore, in similar types of boilers the furnace heat-absorbing surfaces increase proportionally with capacity.

If all of the surface is disposed about the furnace boundary, an increase in boiler unit capacity necessitates an increase in either the furnace width, depth, or height; or an increase in combinations of these three dimensions. However, by employing one or more division walls in the furnace the necessary heat-absorbing surface can be installed while effecting a substantial reduction in boiler size, and consequently building volume. The magnitude of this reduction is shown in Fig. 22 which compares the size of a very large-capacity, high-pressure, high-temperature reheat unit having a furnace fitted with two division walls with the sizes necessary when using one or no division walls. The triple furnace unit considered for comparative purposes and designed for a satisfactory depth and adequate heat-absorbing surface, has a height of 115 ft, a width of 55 ft. 6 in., and a volume of 90,700 cu ft. The use of

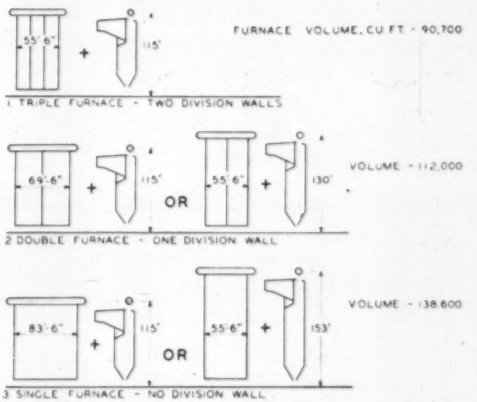


FIG. 22 EFFECT OF DIVISION WALLS ON FURNACE SIZE
(Constant heat-absorbing surface.)

one instead of two division walls would necessitate an increase in height to 130 ft, or an increase in width to 69 ft 6 in., or some combination of smaller increases in both width and height resulting in a furnace volume of approximately 112,000 cu ft. If both division walls are eliminated, the required heat-absorbing surface could be installed by increasing the height to 153 ft, or the width to 83 ft 6 in., or by increasing both the height and width and obtaining approximately 138,600 cu ft of furnace volume. Fig. 23 shows a triple-furnace radiant-type boiler now under construction.

As size is increased by the elimination of furnace division walls the furnace volume increases, resulting in proportionate decreases in the heat-release rates per cubic foot of furnace volume. However, there is no advantage in designing for exceptionally low heat-release rates if flame travel, shape, and location, excess air, and effectiveness and arrangement of heat-absorbing surfaces are satisfactory.

Although space considerations are most important, the use of furnace division walls also offers many other advantages. When using division walls there is considerably more latitude in the establishment of both unit height and width. Therefore superheater and reheater surfaces can be disposed to take full

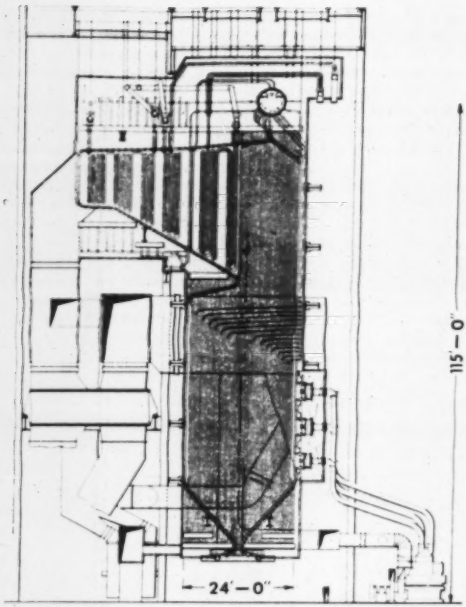


FIG. 23 TRIPLE-FURNACE RADIANT BOILER FOR 1,280,000 LB CONTINUOUS STEAM OUTPUT

(2050 psi design pressure, 1050 F primary and reheat-steam temperatures.)

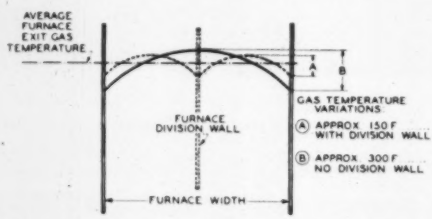


FIG. 24 EFFECT OF FURNACE DIVISION WALL ON VARIATION IN GAS TEMPERATURES ACROSS FURNACE WIDTH

advantage of gas and steam-flow distribution and resistance to flow.

Further, in all furnaces there is usually a considerable variation in the gas temperature across the width of the unit. The tendency is toward temperatures higher than the average at the center of the furnace, and temperatures well below the average at the furnace sides. The differences between the maximum and minimum furnace exit-gas temperatures also tend to increase with boiler width. However, as shown in Fig. 24, the use of a division wall provides, in effect, two smaller-width furnaces and, consequently, reduces considerably the differential between the maximum and minimum furnace exit-gas temperatures. This is most important in the operation of the unit since the expected performances are predicated upon the average furnace exit-gas temperatures. Large variations from this average temperature could result in excessive metal temperatures and slagging in those zones of the superheater which receive furnace gases at temperatures well above the average.

Some indication of the trend toward the use of division walls as the trend to larger unit capacities becomes more pronounced is evidenced by the fact that in the past year the author's company designed 55 utility boilers with furnace division walls. Since their inception, approximately 10 years ago, the company has developed designs for 87 utility boilers having furnace division walls, and 16 units are now in service.

TREND TO HIGHER STEAM PRESSURES—BOILER CIRCULATION

As primary-steam temperatures increase, and designs are developed to reheat to the same temperature, the advantages of higher steam pressures become more pronounced. Consequently, the trend is toward higher steam pressures and, during the past year, 63 per cent of the company's utility-type boilers were designed for pressures of 1800 psi and higher—with one unit designed for 2700 psi. Further indication of this trend is the fact that the company has installed and on order at the present time 65 units designed for pressures of 2000 psi and higher, and averaging 1,000,000 lb of steam per hr per unit.

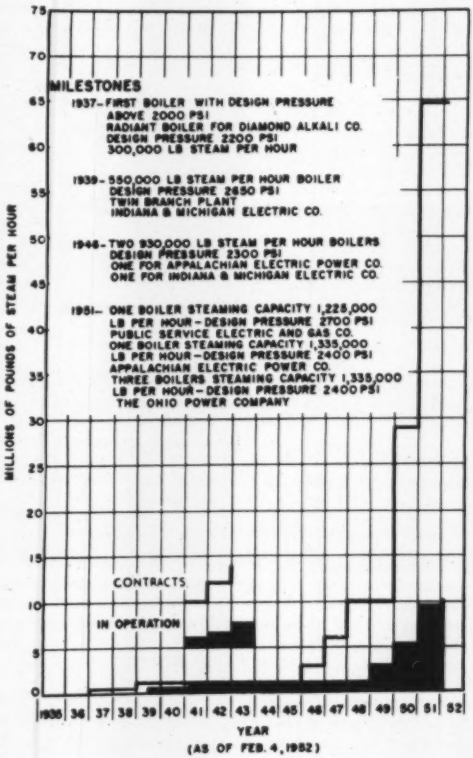

MILLIONS OF POUNDS OF STEAM PER HOUR
MILESTONES
1937- FIRST BOILER WITH DESIGN PRESSURE ABOVE 2000 PSI
RADIANT BOILER FOR DIAMOND ALKALI CO.
DESIGN PRESSURE 2200 PSI
300,000 LB STEAM PER HOUR
1939- 550,000 LB STEAM PER HOUR BOILER
DESIGN PRESSURE 2650 PSI
TWIN BRANCH PLANT
INDIANA & MICHIGAN ELECTRIC CO.
1948- TWO 930,000 LB STEAM PER HOUR BOILERS
DESIGN PRESSURE 2300 PSI
ONE FOR APPALACHIAN ELECTRIC POWER CO.
ONE FOR INDIANA & MICHIGAN ELECTRIC CO.
1951- ONE BOILER STEAMING CAPACITY 1,225,000 LB PER HOUR - DESIGN PRESSURE 2700 PSI
PUBLIC SERVICE ELECTRIC AND GAS CO.
ONE BOILER STEAMING CAPACITY 1,335,000 LB PER HOUR - DESIGN PRESSURE 2400 PSI
APPALACHIAN ELECTRIC POWER CO.
THREE BOILERS STEAMING CAPACITY 1,335,000 LB PER HOUR - DESIGN PRESSURE 2400 PSI
THE OHIO POWER COMPANY
CONTRACTS
IN OPERATION
1936 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52
YEAR
(AS OF FEB. 4, 1952)

FIG. 25 TOTAL STEAMING CAPACITY OF NATURAL-CIRCULATION BOILERS DESIGNED BY THE AUTHOR'S COMPANY FOR PRESSURES OF 2000 PSI AND HIGHER

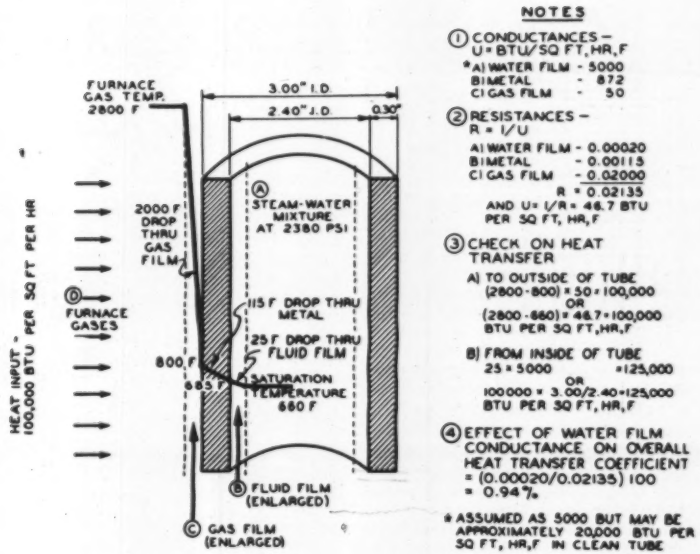

FURNACE GAS TEMP. 2800 F
3.00" I.D.
2.40" I.D.
0.30"
2000 F DROP THRU GAS FILM
A STEAM-WATER MIXTURE AT 2380 PSI
D FURNACE GASES
115 F DROP THRU METAL
25 F DROP THRU FLUID FILM
800 F
683 F
SATURATION TEMPERATURE 680 F
HEAT INPUT - 100,000 BTU PER SQ FT PER HR
B FLUID FILM (ENLARGED)
C GAS FILM (ENLARGED)
NOTES
1 CONDUCTANCES - U = BTU/SQ FT, HR, F
*A) WATER FILM - 5000
BIMETAL - 872
C) GAS FILM - 50
2 RESISTANCES - R = 1/U
A) WATER FILM - 0.00020
BIMETAL - 0.00115
C) GAS FILM - 0.02000
R = 0.02135
AND U = 1/R = 46.7 BTU PER SQ FT, HR, F
3 CHECK ON HEAT TRANSFER
A) TO OUTSIDE OF TUBE
(2800-800) x 50 = 100,000
OR
(2800-680) x 46.7 = 100,000
BTU PER SQ FT, HR, F
B) FROM INSIDE OF TUBE
25 x 5000 = 125,000
OR
100000 = 3.00/2.40 = 125,000
BTU PER SQ FT, HR, F
4 EFFECT OF WATER FILM CONDUCTANCE ON OVERALL HEAT TRANSFER COEFFICIENT
= (0.00020/0.02135) 100
= 0.94%
* ASSUMED AS 5000 BUT MAY BE APPROXIMATELY 20,000 BTU PER SQ FT, HR, F IN CLEAN TUBE

FIG. 26 TEMPERATURE GRADIENTS IN THE TRANSFER OF HEAT FROM FURNACE GASES TO WATER-STEAM MIXTURES

The total steaming capacity, as shown in Fig. 25, is near 65,000,000 lb per hr.

The trend toward high steam pressures has led to reconsiderations of natural and forced (or assisted) circulation; and in any of these analyses it is significant to note that the only utility boilers in operation at pressures in excess of 2000 psi are natural-circulation units. One of these, a reheat unit designed for 2650 psi pressure and operating with a pressure of 2300 psi at the superheater outlet, has been in service for more than 10 years.

In analyses of natural- and forced-circulation units it is most important that all comparisons be on the same basis, and that anticipated future as well as the present trends be considered. Certainly, with present design pressures of 2700 psi it is not unlikely that the next advance may be to units operating at pressures in excess of the critical pressure of 3207 psi.

At present, both the natural- and forced-circulation utility boilers are designed to operate with a good percentage of water in the water-steam mixtures leaving the boiler generating tubes. Consequently, in both designs it is necessary to use steam drums fitted with separating devices to produce steam of acceptable quality. The major difference between the two designs is the method of producing circulation, and there is no doubt that an adequate water supply can be provided for each type of unit—by means of sufficient downcomers in the natural-circulation units and by recirculating pumps in the forced-circulation units. The amount of water supplied for circulation must maintain satisfactory water-steam mixtures in the boiler tubes and, if necessary, provide water-steam ratios in the steam separators which will assure good separation.

Because of differences in design criteria and, perhaps, preferences for specific tube sizes, the water-steam-mixture velocities in the generating tubes will vary in different designs, as well as in different sections of the same unit, even though the percentages of steam in the mixture at the tube exits are similar. However, these differences in velocity have little effect on heat transfer from the inside tube wall to the water-steam mixture. Further, even if it were possible to vary appreciably the inside water-steam heat-transfer rates, there would be no noticeable effect on the over-all heat transfer because this is controlled almost entirely by the outside gas-film conductances, Fig. 26. Therefore, regardless of water-steam ratios and velocities in the tubes, furnace surface requirements would be the same for natural and forced-circulation units designed for comparable conditions, that is, capacity, type of fuel, furnace exit-gas temperatures, and so on.

The superheater, reheater, economizer, and air-heater surface requirements are independent of the type of boiler circulation. Consequently, for identical performance all surface requirements including the furnace, would be similar for natural- and forced-circulation units if they are designed to the same criteria.

In so far as operation is concerned, there should be no difference between start-up time requirements for natural- and forced-circulation units since these are dependent primarily upon the allowable gas temperatures entering the superheater and reheater with little or no steam flow, and the metal temperature differentials in the steam drum. During shut-downs, both types of units should perform similarly until the water in the system reaches a temperature of 212 F. As temperature is reduced below 212 F some decrease in cooling time may be effected by using the recirculating pumps to continue circulation of water through the drum.

Therefore, in present types of natural- and forced-circulation utility boilers the surface requirements should be comparable, the steam-separation requirements similar, and the start-up and shut-down time requirements almost identical for given performance requirements and design criteria.

Future trends in forced-circulation designs may differ considerably from those recently inaugurated, particularly if the boilers operate at pressures above the critical pressure. At

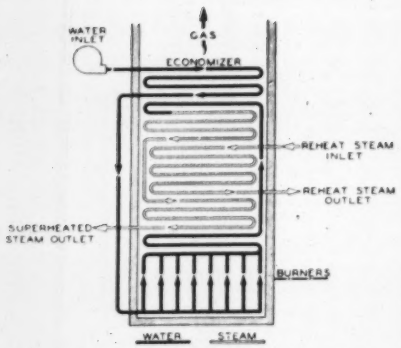


FIG. 27 SCHEMATIC ARRANGEMENT OF FORCED-CIRCULATION ONCE-THROUGH BOILER FOR OPERATION AT STEAM PRESSURES ABOVE 3207 PSI

these pressures it would not be necessary to separate steam from water and, therefore, forced-circulation units probably would be of the once-through type, as shown diagrammatically in Fig. 27; and recirculating pumps, steam drums, and separators would not be required. If such types are developed in the future the configuration of the units should be far different from those now in vogue.

RECENT DEVELOPMENTS IN METHODS OF FIRING

During the past 10 years many interesting developments have been projected and utilized, and some of these have been reviewed, in the discussion of the trends to higher steam pressures and temperatures, larger-capacity units, and increased use of reheat.

The use of such other developments as pressure firing and cyclone furnaces has become quite general and, consequently, they have created definite trends in boiler enclosures and methods of firing. More than 75 utility-type boilers, built by the author's company, have been provided with pressure casings to increase efficiency, minimize gas quantities, reduce resistance to gas flow, and eliminate induced-draft-fan maintenance.

The company also has designed 31 cyclone-furnace boiler units and 20 of these are now in operation. A recent design of a large-capacity cyclone-fired radiant boiler is shown in Fig. 28. This type of firing was developed in an effort to minimize fly-ash problems, reduce carbon losses, handle coals containing considerable ash and pyrites, and reduce induced-draft-fan maintenance.

Actual performance with a number of different coals has fully substantiated pilot-plant tests. Cyclone furnaces have operated with low excess air and practically no carbon losses. Fly ash has been reduced to less than 10 per cent of the ash in the fuel, and even when dust collectors were not installed there was no induced-draft-fan erosion.

CONCLUSIONS

The developments of the past decade, and particularly the past few years, indicate certain trends in the company's utility-type boiler units which can be summarized briefly as follows:

1 The average unit size has increased appreciably and is now about 1,000,000 lb of steam per hr.

2 The percentage of reheat units has increased rapidly and

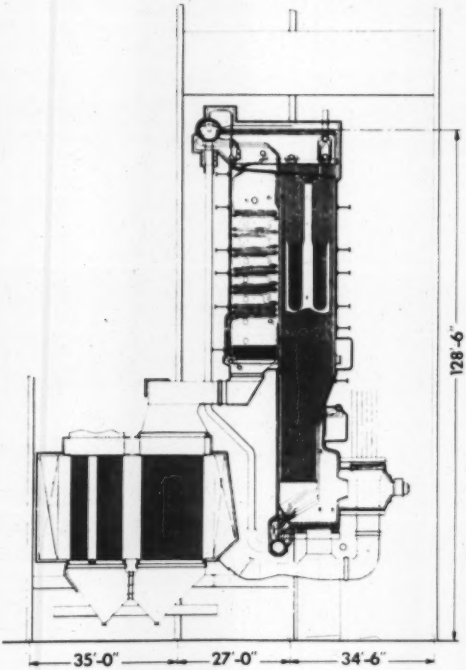


FIG. 28 CYCLONE-FIRED RADIANT BOILER FOR 1,200,000 LB CONTINUOUS STEAM OUTPUT WITH RADIANT-CONVECTION SUPERHEATER

(2125 psi design pressure, 1050 F primary and 1000 F reheat steam temperatures.)

at present a very large proportion of utility boilers is of the reheat type.

3 The average steam pressure is about 1800 psi and the majority of new units are for design pressures well in excess of 1800 psi. A natural-circulation unit has been sold for 2700-psi design pressure.

4 Average steam temperatures have reached 1000 F and many reheat units have been designed for primary and reheat temperatures of 1050 F. A few units have been designed for primary-steam temperatures of 1100 F and reheated-steam temperatures of 1050 F.

5 Temperature control is now applied to both superheated and reheated steam. The majority of reheat units use gas recirculation in combination with spray attemperation as the basic means of temperature control.

6 Pressure firing is utilized in many recent designs.

7 Cyclone furnace, instead of pulverized-coal firing, has been used in a number of recent installations.

ACKNOWLEDGMENT

The author wishes to thank his associates, particularly Messrs. C. B. Baver, J. C. Delibert, E. G. Kispert, P. R. Loughin, C. L. Marquez, H. H. Nelken, A. E. Raynor, and C. S. Smith for their most helpful comments and constructive criticism.

BEARINGS, LUBRICANTS, *and* LUBRICATION

A Digest of 1951 Literature[1]

JOURNAL BEARINGS AND BEARING MATERIALS

A NUMBER of advances and refinements of bearing theory were published in 1951. Burwell (1)[2] calculated the performance of dynamically loaded narrow sleeve bearings using the assumption of Michell, Cardullo, and Ocvirk that in narrow bearings oil flow in the axial direction is so large compared to oil flow, due to film pressure, in the direction of motion that the latter may be neglected. The resulting simplified differential equation was solved, and the results compared for several simplified types of loading with the solutions for the infinitely wide bearing with no axial flow. The general nature of the results is similar, suggesting that solutions for intermediate cases may be of similar form and determinable in terms of the two limiting solutions. Gatcombe (2) calculated the theoretical load capacity of fluid films trapped between the peripheral surfaces of rotating disks under steady-state conditions where the rim-to-rim distance is small but constant It has not been possible to calculate performance under non-steady-state conditions where the rim-to-rim distance varies periodically, but Gatcombe by careful experimental technique has measured the load capacity as a function of film thickness. The dynamic capacity has been observed to be as high as 6 times the corresponding static capacity, a fact which helps explain the high capacities found between gear teeth and in bearings under dynamic loading conditions.

Linn and Burwell (3) gave a complete discussion of bearings and lubrication for marine turbines and reduction gears including the fundamentals of bearing design, construction, calculation and operation, bearing materials, oil leakage, and oiling systems. Typical calculations show that this type of bearing is designed to run at moderate eccentricities and reasonably large film thicknesses. Wilcock and Rosenblatt (4) show the key importance of oil flow in determining sleeve-bearing performance and give procedures for computing oil flow and for predicting bearing power consumption and temperature rise. Oil flow is assumed to be of two types: (*a*) The flow through the clearance space and chamfers caused by applied inlet pressure; and (*b*), the flow caused by the load-supporting pressures generated in the oil film by shaft rotation. Outlet-oil temperature is shown to be the most reasonable for determining average oil viscosity, for the bearing acts like a mixer. Outlet-oil temperature is computed as a function of average oil viscosity, and the intersection of this curve with the viscosity-temperature curve of the oil gives the operating condition for the bearing. Because of decreased shearing area in the expanding portion of the oil film, Petroff's law is found to be a good approximation up to eccentricities of 0.7. Froessel (5) discussed the advantages of subdividing bearing surfaces by cutting three or four axial grooves into the surface, thereby creating additional zones of support. Hitchcock (6) reports results on the loads, speeds, and operating temperature of roll-neck bearings. Mueller (7) discusses air-lubricated bearings and the principles determining the performance of bearings supplied with air from an external pressure source. Journal, thrust, and flat bearings are described, together with the necessity for metering orifices and the effect of clearance on the pressure distribution between the supply source and the bearing. Reduction of clearance increases the bearing pressure and effects a potent restoring force to maintain equilibrium.

Roach (8) has evaluated the ability of several typical bearing materials to tolerate abrasive dirt in the lubricant by testing in actual bearings. Rate of temperature rise offers a means of rating the embeddability performance of bearing materials. Bearings surfaced with a thin layer of babbitt will tolerate dirt with a maximum particle size about equal to the thickness of the babbitt layer. In a study of the effect of size of contaminating particles present in a lubricant upon the rate of wear encountered in an internal-combustion engine, Wellinger (9) describes bench equipment and results of tests conducted in it. Abrasive wear for a constant sliding distance is found to increase with particle size and bearing load, decrease with sliding speed, and to depend specifically on the metal pair tested.

Nowell (10) used a modified Amsler wear testing machine to study the operation of steel-backed babbitt bearings under low speed, high load conditions. Similar tests for comparing bearing materials and for comparing lubricants are proposed. Hardy, Liddiard, Higgs, and Cuthbertson (11) describe improved aluminum-tin and aluminum-tin-copper alloys. More than 1 per cent tin is found advantageous when the large tin segregations are broken up by cold-working.

Announcement (12) was made of the application of cemented tungsten carbide for journals and bearings under high speed, load, and temperature conditions where conventional bearings fail. Among other applications, high-speed, heavily loaded grinder spindles held to very close bearing clearances have been made from this material.

BALL AND ROLLER BEARINGS

Continued studies by Macks and Nemeth (13) of high-speed cylindrical roller bearings produced evidence that oil-inlet location and angle affect race temperatures. Higher single jet oil velocity reduced the temperatures whereas higher bearing speeds increased it markedly as would be expected. The effects of various operating variables on the inner and outer-race temperatures of cylindrical roller bearings at high speeds are shown by Macks, Nemeth, and Anderson (14). The significance of operating temperature is related to bearing operating limitations, and a correlation for predicting race temperatures from a single curve is given.

Aircraft gas-turbine bearing-lubrication problems are discussed by Phillips (15) with the conclusion that ball and roller bearings are superior to journal bearings and that solid oil jet feed is superior to mist lubrication. Experience shows that the entire gas turbine can be lubricated satisfactorily with a very light oil and that such an oil is necessary for temperatures

[1] Report prepared by Dr. J. C. Geniesse and N. A. Hartung with the assistance of the ASME Lubrication Research Committee. The summary for the year 1951 was based on the Engineering Index references on Bearings and Lubrication.

[2] Numbers in parentheses refer to the Bibliography at the end of the paper.

below —30 F. Tests show that silver-plated or Monel separators are far superior to brass separators in preventing the formation of varnish deposits caused by high heat conditions immediately after shutdown. Detailed data obtained by Boyd and Eklund (16) on aviation gas-turbine ball and roller bearings of various sizes and designs showed the effect of load, speed, oil flow, and temperature on the behavior of the bearings at high speeds.

Krouse (17) reports formulas that have been developed for checking the actual geometric conditions which arise in ball bearings with double-curvature races in order to illustrate the effects of temperature variation across the bearing components when used at speeds encountered in gas turbines and compressors. The effect of centrifugal forces and loads in increasing the probability of failure of high-speed ball bearings is discussed by Jones (18).

THRUST BEARINGS

The development of the Kingsbury thrust bearing is described by its originator, Albert Kingsbury (19). This article, appearing seven years after Dr. Kingsbury's death, gives in condensed form a history of the inventor's career from high-school days up to the general acceptance of his bearing by the engineering world. He discusses in some detail his early activities in lubrication research, leading to the development of the pivoted-shoe thrust bearing.

A solution of the Reynolds equation for a 45-deg "square" sector-shaped thrust bearing pad, has been given by Brand (20). The solution, obtained by means of relaxation methods, compares favorably with previously published results obtained for rectangular sliders and shows that the method can be applied safely to sector-shaped pads when the film-wedge angle is not too large.

Investigations into the friction characteristics of parallel and tapered-land thrust bearings are reported by Rorke and Blevings (21). Effects of radial taper and circumferential taper are investigated separately. The number of segments is varied by dividing an annular thrust surface by means of radial grooves. The effect of length-width ratio on the friction of the bearing is also investigated. Curves show the variation of friction coefficient with radial taper, with circumferential taper, and with length-width ratio.

Investigations of the effect of surface macroroughness on the performance of the parallel-faced thrust bearing and an explanation of its behavior are reported by M. E. Salama (22). The problem is treated both theoretically and experimentally, and the main result reached indicates that macroroughness is a prime factor in the behavior of the bearing, as it provides passages which both feed the surfaces with lubricant and allow the formation of hydrodynamic films so that the performance corresponds more closely to that for film lubrication.

A new approach to the solution of the Reynolds equation for the case of plane slider bearings with side leakage has been made by Charnes and Saibel (23). By assuming an exponential variation of film thickness, solutions are obtained in the form of rapidly convergent series for pressure distribution, total bearing load, center of pressure, coefficient of friction and oil flow.

AUTOMOTIVE LUBRICANTS

Crankcase oil additives and their effect on oil-ring plugging, oil consumption, and engine wear are discussed by Geniesse and Schreiber (24). The use of the radioactive tracer technique for measuring wear is described. Fleet and engine tests under light loads reported by Howe (25) demonstrate that high-additive-content crankcase oils reduce engine deposits by 50 per cent and ring wear by 80 per cent.

Strang and Burwell (26) used radioactive chromium on plated piston rings to measure microwelding or transfer of metal to the cylinder wall. It was shown that this transfer is greatest at the top of the ring travel and somewhat less severe at the bottom of the stroke. Metal transfer was found to be independent of the pressure above the piston.

Radioactive tracer technique is described by Leicester (27) including several applications of which two are on lubrication. Radioactive piston rings make possible several tests between each engine dismantling; thus many tests can be run in the time previously taken by a single one when internal measurements were used to determine rate of wear. This technique also has been used with lubricating-oil additives containing radioactive sulphur to determine their role in lubrication.

METALWORKING LUBRICATION

Lauterbach and Ratzel (28) have demonstrated that, for low cutting speeds (below 10 sfpm), a cutting fluid gets to the cutting edge of a tool by penetrating the clearance crevice between the tool and workpiece and not by the rake crevice between the tool and chip. No information on the mechanism of fluid penetration could be determined at higher cutting speeds by any of the methods which were used.

Using the tool-chip contact as a thermocouple to measure tool-point temperature and employing techniques which give reliable results in the presence of cutting fluids, Shaw, Pigott, and Richardson (29, 30) find that the cooling effectiveness of a fluid decreases as the depth of cut is increased or as the cutting speed is increased. Further, there is a limit for both depth and speed at which the fluid no longer reduces tool-chip temperature. They also find that tool temperatures, as determined by chip-temper colors, can be varied readily by changing cutting conditions without changing the chip-tool temperature. No correlation was obtained between cooling effectiveness and cutting friction.

Iwascheff (31) was able to show, in a series of tests under actual production conditions, that a flood of coolant, properly applied, improved surface finish, allowed higher cutting speeds and increased tool life. Niebusch and Strieder (32), in a review of several different cutting and grinding operations, also testify to the need of applying a cutting fluid in copious quantities at the proper point and recommend, as a "rule of thumb," that flow rate in gallons of cutting fluid per minute be set numerically equal to maximum horsepower required for cutting.

The latest theories of metal cutting, with comments on the role of cutting fluid are reviewed by Merchant (33). Although not immediately concerned with research on lubrication in metal cutting, the valuable investigations of Chao and Trigger (34) on tool-chip temperatures should be mentioned since their information on the dynamics of metal cutting has application in this field.

The grinding process was investigated by Outwater (35), who examined the cutting action of single grains of abrasive. He found that the atmosphere plays a dominant role and that oxygen, even at low pressure, is remarkably effective in reducing friction in grinding. The main effect of the grinding fluid is to control the bulk metal temperature after the cutting action is completed and to reduce friction between the severed chip and uncut metal. In the fourth paper in a series on cylindrical grinding, McKee, Moore, and Boston (36) critically examine the effects of grain size and type of grinding compound in terms of volume of metal removed per volume of wheel wear, specific horsepower requirements, surface finish, surface temperature increase, hardness increase, and quench or skin effects. The merit rating of a given fluid is highly dependent upon the choice of metal and conditions of cutting and, to a marked degree, upon the relative weight given to different criteria.

A special dynamometer for measuring torque and thrust loads on a drill was constructed by Brain and Hulf (37) for investigating the behavior of cutting fluids in this operation. In a review article on drilling, Sack (38) makes recommendations for increasing efficiency and includes suggestions for the selection of coolants and cutting fluids.

The surface activity of cutting fluids continues to receive special attention by a number of Russian investigators including Zhadin (39) and Epifanov (40).

Soluble cutting fluids, which constitute over half of the cutting fluids used in this country, are receiving increased research attention. Most of the work is described in connection with the process for which they are used. Lindert (41), studying them on their own merit, examined the "blue-black" spotting occasionally encountered in the use of such fluids and offers a coherent chemical explanation for its occurrence together with recommendations for its elimination. He also assesses the potential health hazards arising from bacterial contamination.

For the metal-drawing processes, sulphide and phosphate coatings received special attention during the past year. Knerr (42) describes a lead-coating process which strongly resists removal and thus permits repeated cold deformations without reapplication. Henricks (43) discusses a low-friction sulphide coating for ferrous metals which can be formed by vapor-phase sulphurization during annealing, thermal decomposition of a predipped coating, by chemical conversion of an oxide coating or by a hot aqueous solution. A phosphate coating is recommended for the cold extrusion of steel by Hauttmann (44) while a special phosphate coating is suggested for a variety of processes (45 to 48).

Measurements of temperatures resulting from bar and wire-drawing were used by Reichel (49) for examining lubricants and coolants. Lubricants for cold-working nonferrous metals were reviewed by Chrisholm (50, 51) and for general operations by Bastian (52). Lubricants for rolling stainless steels are discussed by Bible (53).

The influence of lubricants upon the efficiency of wire-drawing with carbide dies under a variety of conditions has been investigated by Baron and Thompson (54). Wistreich (55, 56) concludes that "ringing" or grooving of drawing dies, near the point of entry of the wire into the die, is due to the steep stress gradient in the die and is not due to abrasive solids which may contaminate the lubricant. A review of lubricants for wire-drawing is given by Snigel and Verner (57).

BOUNDARY LUBRICATION

Solid Friction. Many of the papers published during 1951 confirm the fact that solid friction is due to shearing of welds formed by plastic deformation caused by intense local loading or tangential stress (58 to 66), although Schnurmann (67) presents evidence that solid friction may be, in part, electrostatic in origin.

Studies of metal transfer or pickup on sliding, by irradiation of one surface before or after sliding, is proving to be a powerful tool for study of friction and wear (62 to 65). It is shown that metallic wear, though generally varying in the same direction as friction, may change by an enormously greater ratio, so that the coefficient of friction may not be a good index of wear.

Evidence of chemical action at the surface due to sliding is reviewed by Clayton (68). Moore and Tegart (61) have confirmed this and have advanced the view that the nature of the oxide film formed during sliding may influence greatly the nature of the wear.

Organic Boundary Lubricants. Recent work by many authors (69 to 76) has shown that boundary lubricants react with base-metal surfaces, forming a strongly oriented soap film of high melting point. When no reaction occurs, as with inactive polar lubricants or precious metals, there is evidence of strong orientation. Menter (71) reports electron-diffraction data on films of reactive and unreactive polar compounds on base and noble metals; in all cases, orientation roughly normal to the metal surface was observed. Moore (74) presents results on similar systems, using radioactive surfaces to demonstrate that reaction takes place. Hirst (73) indicates that water is necessary for the reaction between a fatty acid and metal oxide to take place.

The ability of these films to lubricate is shown by Barwell and Milne (75) to depend on the melting point of the actual lubricant—soap where reaction has occurred, or hydrocarbon where no reaction occurs. The lubricating qualities of the solid films are shown to be superior to those of melted films, that is, lubricants operating above their melting points. Shooter (76) and Moore (74) both present evidence of the need for multilayer soap films for effective boundary lubrication. The friction reduction due to a monolayer of fatty acid is small; however, in a reactive system where good boundary lubrication is observed, the formation of multiple layers of soap is observed.

Solid Lubricants. Further evidence is given by Bowden and Young (58, 59) and Finch and Spurr (60) that oxide and organic films on metals, and adsorbed gas films on diamond and gas-carbon, cause the low frictions measured on technically "clean" surfaces in air. Finch (77) states that the lubricity of layer-lattice lubricants like graphite and molybdenum disulphide is due to adsorbed films on the layers which lower shear resistance by facilitating a "peeling" action. These lubricants should be in the form of plates of minimum thickness and maximum surface area. Phosphate films on steel surfaces have been shown by Barwell (78, 79) and Barwell and Milne (80) to be effective aids to lubricity, especially when supplemented with paraffin wax or molybdenum disulphide.

Fretting. The effect of molybdenum disulphide, applied by different methods, on the fretting failure of steel-glass and steel-steel combinations was determined by Godfrey and Bisson (81). Fretting cannot be prevented unless a film, thick and coherent enough to prevent all contact, is made on the surfaces. The best films delayed the onset of fretting for 28×10^6 cycles for steel-glass and 10×10^6 cycles for steel-steel.

Wear studies by Mason and White (82) on various metal-metal and metal-nonmetal combinations undergoing oscillatory tangential motion at supersonic frequencies confirm the results of previous work on metals at low frequencies in showing that there is a sharp transition between insignificant and rapid wear at a critical amplitude sufficient to cause gross slip between the surfaces. The apparatus used, described by Mason and White (82) and Mason and Wick (83), is capable of producing up to 0.005 cm of motion from 500 to 18,000 cycles per sec and is designed so that displacement-time curves and force-displacement curves can be followed on an oscilloscope. The volume of wear for one billion operations is found to be proportional to the product of the static force and the length of the stroke. The rate of wear falls off rapidly with time. Calculations show that only about one part in 10^9 of the energy goes into producing wear, the rest going into heat production. The critical amplitude increases as the two-thirds power of the normal load and inversely as the two-thirds power of the shear stiffness, so that materials with a low shear elastic constant such as rubber will show a lower wear rate than a stiff material such as steel. The total displacement for no slide increases as the two-thirds power of the static load. Theoretical analysis of the conditions operating in the region of no gross slip leads to the assumption that local slip occurs within the area

of contact. This assumption is verified experimentally for oscillating tangential stresses applied to a spherical glass lens between two rigidly held plane glass surfaces, where theory predicts that local slip will occur between these lenses over a circular annulus (84, 85).

Thin-Film Lubrication. The question of anomalous flow of liquids between surfaces separated by very thin films is revived by Mardles (86) in experiments on the rate of spreading of pools of liquid over horizontal polished surfaces or between optical flats. This spreading behavior has been correlated with friction results on the same surfaces by Bielak, Mardles, and Tingle (87). Observed deviations from the simple mixing law are attributed to changes in the molecular association of the liquids on mixing.

Marcelin (88) reports further data on friction experiments conducted dry and with very thin lubricant films, from which he concludes that the laws of friction in a given case depend on the metals used, finish, load, lubricant, temperature, and lengt of run.

Tests reported by Borsoff, Accinelli, and Cattaneo (89) on spur gears with mineral oils of various viscosities developed a definite relationship between the maximum horsepower which the gears can transmit without scoring and the product of gear speed and lubricant viscosity. Introduction of a viscosity factor in the Lewis equation for gear design gives an equation consistent with data obtained by the authors. The modified Lewis equation and data show the influence of viscosity to be a factor not to be neglected in gear design.

Clark, Woods, and White (90) examined lubrication under extreme pressures with mineral-oil films, using as a bearing the contact area between crossed-axis steel cylinders. Evidence indicating intact oil films at average pressures ranging from 86,000 to 215,000 psi is interpreted as an indication of partial oil solidification under these conditions.

Research Techniques. A method for mounting specimens for successive electron-diffraction studies while temperature is increased continuously from room temperature to 1000 C is described by Menter and Sanders (69). The usefulness of a new technique for autoradiographic studies of metal pickup in which the surfaces are irradiated after the friction experiments are completed has been demonstrated by Rabinowicz (64). A two-ball machine was used by Lane (91) to indicate that for every combination of lubricant and sliding system there is a characteristic temperature where lubrication fails and scuffing occurs.

Miscellaneous. Studies by Critchlow and Flynn (92) of wire rope subjected to pulsating tensile stress show the importance of lubricating the core and the strands of wire rope. Static friction measurement is used by White and Zei (93) for evaluating oiliness of a large number of proprietary and specially compounded lubricants. In this work graphite and molybdenum disulphide are shown to give marked lowering in friction when added to a lubricating oil. Interesting studies of the friction of yarn treated with various lubricants against steel are described by Moss (94). There is no apparent relation between coefficient of friction and lubricant structure, paraffin wax being the best lubricant tried. A good discussion of the importance of lubrication for knitting and weaving of cottons and other textiles is given. Williams (95) reviews the properties and applications of carbon brushes and bearings.

PROPERTIES OF LUBRICANTS

Viscosity. In a symposium on methods of measuring viscosity at high rates of shear, Fenske, Klaus, and Dannenbrink (96) give determinations on a high-shear viscosimeter indicating that polymer-containing fluids become non-Newtonian at a fairly well-defined shear rate. Needs (97) shows that determinations over a wide range of temperature and rate of shear indicate that straight mineral oils show no deviation from Newtonian viscosity attributable to rate of shear, while oils containing the polymers showed a decrease in shear stress with increased rate of shear.

A progress report by Bradbury, Mark, and Kleinschmidt (98) contains a description of apparatus and methods employed in obtaining data on the viscosity of a selected group of lubricants over a wide range of pressure and temperature, together with typical charts for several lubricants. Apparatus for imposition of high shear rates on oils containing high polymers is described by Wood (99). Ward, Neale, and Bilton (100) used a high-speed rotational viscosimeter and a very thin oil film to measure the viscosity of lubricating oils, with and without viscosity-index improver, and at high rates of shear.

Synthetics. The first symposium on synthetic lubricants, sponsored by the American Chemical Society, reviews the excellent work being done in the field by these products. The work of Murphy and Zisman (101) indicates that atomic structure influences viscosity-temperature characteristics and freezing point. Their work includes studies of boundary friction, lubrication, and rust inhibition. Larsen and Bondi (102) found fluorocarbons chemically inert but with poor viscosity index while the silicones have oxidation stability and good viscosity index but are poor lubricants. Larger quantities of most extreme-pressure additives must be used than in the corresponding hydrocarbons. Data comparing the properties of these fluids with hydrocarbon characteristics are given. Reysen and Gibson (103) have combined the information contained in a series of five reports concerning the relationships among physical properties of chlorotrifluoroethylene polymers in tabular and graphical form for more convenient use.

Glavis (104) presents the general effects on viscosity and viscosity index of blends of polymeric additives and synthetic ester-type lubricants. Improvement in viscosity index is obtained where the polymeric additive is soluble in the particular ester involved. Murphy, Ravner, and Smith (105) describe the oxidation-inhibition action of phenothiazine-type compounds on a diester-type lubricating oil, in a dynamic system, over the temperature range of 100 to 175 C in the presence of metal catalysts. Variations in antioxidant action with changes in its molecular configuration are discussed.

Millett (106) shows that polyalkylene-glycol fluids are utilized widely in lubricating and nonlubricating applications at both high and low temperature. They have good thermal stability, high viscosity index, and do not sludge. Many industrial applications are cited. Sweatt and Langer (107) describe applications of polyalkylene-glycol lubricants based upon actual performance records.

Data on organopolysiloxanes as lubricants under thin-film or boundary conditions are reported by Currie and Hommel (108). These fluids possess many desirable characteristics such as high flash points, low freezing points, extremely flat viscosity-temperature slopes, high resistance to oxidation and thermal decomposition. Greases formulated from these materials are indifferent to extreme temperature changes, have low solidification points, and remarkable heat stability. Currie and Smith (109) describe the rheological properties of the same fluids. Their data describe the behavior of siloxane fluids and lithium soap-base greases made from these fluids subjected to relatively high shear rates. Murphy, Saunders, and Smith (110) show that polymethylphenylsiloxanes have greater thermal oxidation stability than the polymethylsiloxanes. The same metals accelerate decomposition and oxidation in both. A paper by Grant and Currie (111) gives a summary of the physical properties and performance of silicone fluids and greases as used

commercially and classified according to physical state, chemical structure, and kind of thickening agent used.

MISCELLANEOUS

Noncatalytic polymerization of 1-olefins produces excellent lubricating oils, according to Seger, Doherty, and Sachanen (112). Given suitable olefinic charging stocks, the conversion to finished high-grade lubricating oils can be accomplished in conventional refinery equipment.

Schweitzer and Szebehely (113) report a wide variation in the solubility constants and rates of solution of air in lubricating oils, fuel oils, and water but found the rate of evolution or solution proportional to super or undersaturation, respectively. They also discuss the phenomenon of cavitation.

Sawyer (114) reports a study comparing the catalytic effect of metals on the oxidation of mineral oils, using eight oils, nine metals, and glass. The catalytic effect of the various metals increased with increasing temperature and appeared to be dependent upon surface area.

A symposium (115) on analytical research in the petroleum industry has been published. This group of 14 papers deals with applications of spectrography, polarography, and ultraviolet and infrared spectrophotometry; recent advances in certain phases of physical and chemical testing are also treated.

BOOKS

A number of books dealing with the theory and practice of lubrication have been published recently. In a volume entitled "The Friction and Lubrication of Solids," Bowden and Tabor (116) have developed the weld theory of solid friction in great detail. Analyses of contact areas, temperatures of rubbing surfaces, frictional heating and surface damage, and the mechanisms of boundary and extreme-pressure lubrication are included. In addition, studies of bearing metals, metallic wear, and the effect of impact on lubricant films are described. This book contains a wealth of scientific data, all well correlated with the theories of friction and lubrication to which the authors subscribe and which they have done so much to develop.

Another contribution to the theory of lubrication has been made by the *British Journal of Applied Physics* (117) in publishing "Physics of Lubrication," a symposium of 18 papers containing reviews and new data on hydrodynamic, boundary, and extreme-pressure lubrication. Many aspects of boundary lubrication in particular are presented with considerable new experimental evidence. The papers containing new data have been reviewed and included in the appropriate section of this digest.

In "Lubrication: Its Principles and Practice," Michell (118) approaches lubrication problems from a theoretical point of view, which would be of particular interest to a lubrication specialist. The physical properties of lubricants, notably viscosity and flow characteristics, and bearing designs are discussed at length. The author treats boundary phenomena as a mixture of solid-contact and fluid friction, and makes no mention of polar or chemically active compounds.

Three books dealing with the practice of lubrication have appeared. Georgi (119) in "Motor Oils and Engine Lubrication," gives comprehensive coverage to the manufacture, properties, and testing of motor oils. The application of these oils and the relationship of lubrication to engine design, operation, and maintenance are treated. In "Metalworking Lubricants," Bastian (120) covers all types of fluids and compounds used in metalworking processes and in forming nonmetallic engineering materials such as plastics. Supplementing the text are illustrations of shop operations, table of fluid properties, and application charts. A fourth edition of the comprehensive treatise by Thomsen (121), "The Practice of Lubrication," deals with the properties and methods of testing lubricants and lubrication practice for the most important types of industrial machinery, including internal-combustion engines.

A compilation entitled "The Fundamental Aspects of Lubrication," has been published by the New York Academy of Sciences (122). Included are thirteen papers by authorities on various phases of lubrication. Among the subjects treated are hydrodynamic and thin-film lubrication, friction, surface damage, adsorption, grease structure, physical properties of lubricants, and metal cutting.

In the Proceedings of the Third World Petroleum Congress, Section VII (123), five papers appear dealing with viscosity-temperature-pressure relations, gear and boundary lubrication and metalworking. Six other papers in this volume treat pour depressants, greases, and motor oils.

"Physical Chemistry of Lubricating Oils," by Bondi (124) is a comprehensive volume on the physical-chemical properties of oil. P-V-T relations, rheology, surface phenomena, optical and electrical properties, type analysis, phase equilibriums, and reaction kinetics of hydrocarbons in the lubricating range are discussed. A chapter on synthetic lubricants is included.

The proceedings of a conference on wear held at the Massachusetts Institute of Technology in 1948, have been published by the American Society for Metals under the title "Mechanical Wear" (125). A number of the papers included in this symposium are concerned with lubrication in some degree.

1950 LITERATURE REFERENCES

A number of literature references for papers published in 1950 were not covered by this or the 1950 digest (126 to 137). They are appended herewith in title form only in the interest of furnishing as complete a record as possible.

BIBLIOGRAPHY

1 "The Calculated Performance of Dynamically Loaded Sleeve Bearings—III," by J. T. Burwell, *Journal of Applied Mechanics*, Trans. ASME, vol. 73, 1951, pp. 393–404.

2 "The Nonsteady-State Load-Supporting Capacity of Fluid Wedge-Shaped Films," by E. K. Gatcombe, Trans. ASME, vol. 73, 1951, pp. 1065–1075.

3 "Bearings and Lubrication for Marine Turbines and Reduction Gears," by F. C. Linn and J. T. Burwell, Jr., *Marine Engineering and Shipping Review*, vol. 55, December, 1950, pp. 47–54.

4 "Oil Flow, Key Factor in Sleeve-Bearing Performance," by D. F. Wilcock and M. Rosenblatt, Trans. ASME, vol. 74, July, 1952, pp. 849–866.

5 "Rein hydrodynamisch geschmierte Gleitlager (Mehrgleitflaechenlager)," by W. Froessel, *Stahl und Eisen*, vol. 71, February 1, 1951, pp. 125–128; English abstract in *Engineers' Digest*, vol. 12, May, 1951, pp. 154–155.

6 "Load, Speed and Operating Temperature of Roll Neck Bearings," by J. H. Hitchcock, *Lubrication Engineering*, vol. 6, 1950, pp. 252–255.

7 "Air Lubricated Bearings," by P. M. Mueller, *Product Engineering*, vol. 22, August, 1951, pp. 112–115.

8 "Performance of Oil-Film Bearings With Abrasive-Containing Lubricant," by A. E. Roach, Trans. ASME, vol. 73, 1951, pp. 677–686.

9 "Einfluss der Korngrosse von Quarzstaub auf das Verschleissverhalten verschniedener Werkstoffpaarungen," by Karl Wellinger, *Zeitschrift des Vereines deutscher Ingenieure*, vol. 92, 1950, pp. 371–375.

10 "Investigation of Bearing Materials Under Various Degrees of Lubrication in Low-Speed Range," by L. A. Nowell, Jr., ASTM Bulletin No. 168, September, 1950, pp. 47–53.

11 "Improved Aluminum Bearings (Al-Sn and Al-Sn-Cu Alloys)," by H. K. Hardy, E. A. G. Liddiard, J. Y. Higgs, and J. W. Cuthbertson, *Metal Progress*, vol. 60, October, 1951, pp. 97–103, 224.

12 "Important New Carbide Developed by Carboloy," *Machinery*, vol. 58, 1951, pp. 185–186.

13 "Investigation of 75-Mm Bore Cylindrical Roller Bearings at High Speeds II—Lubrication Studies—Effect of Oil-Inlet Location, Angle, and Velocity for Single-Jet Lubrication," by E. F. Macks and Z. N. Nemeth, NACA Technical Note 2216, November, 1950.

14 "Operating Characteristics of Cylindrical Roller Bearings at High Speeds," by E. F. Macks, Z. N. Nemeth, and W. J. Anderson, Trans. ASME, vol. 74, July, 1952, pp. 705–713.

15 "Lubrication—Bearing Problems in Aircraft Gas Turbines," by E. M. Phillips, MECHANICAL ENGINEERING, vol. 73, 1951, pp. 983–988.

16 "Some Performance Characteristics of Ball and Roller Bearings for Aviation Gas Turbines," by John Boyd and P. R. Eklund, ASME Advance Paper No. 51-A-78, November, 1951.

17 "Ball Bearing Geometry," by Roy Krouse, *Machine Design*, vol. 23, 1951, pp. 158–162.

18 "The Life of High-Speed Ball Bearings," by A. B. Jones, Trans. ASME, vol. 74, July, 1952, pp. 695–703.

19 "Development of the Kingsbury Thrust Bearing," by Albert Kingsbury, MECHANICAL ENGINEERING, vol. 72, 1950, pp. 957–962.

20 "The Hydrodynamic Lubrication of Sector-Shaped Pads," by R. S. Brand Trans. ASME, vol. 73, 1951, pp. 1061–1063.

21 "Friction Tests on Parallel and Taper Land Thrust Bearings," by John Rorke and J. F. Blevings, *Journal of the Royal Technical College*, Glasgow, Scotland, vol. 5, 1950, pp. 258–261.

22 "The Effect of Macro-Roughness on the Performance of Parallel Thrust Bearings," by M. E. Salama, Proceedings of The Institution of Mechanical Engineers, vol. 163, 1950, pp. 149–158.

23 "On the Solution of the Reynolds Equation for Slider-Bearing Lubrication—I," by A. Charnes and E. Saibel, Trans. ASME, vol. 74, July, 1952, pp. 867–873.

24 "Motor Oil Additives," by J. C. Geniesse and W. Schreiber, *Oil and Gas Journal*, vol. 49, March 29, 1951, pp. 302–305, 307.

25 "Effect of Fuels and Lubricants in Utility Fleet Operations," by W. A. Howe, *Gas Age*, vol. 108, July 19, 1951, pp. 39–43, 82.

26 "Metal Transfer From Piston Rings to Cylinders During Run-In," by C. E. Strang and J. T. Burwell, *Scientific Lubrication*, vol. 2, October, 1950, pp. 24–27.

27 "The Application of Radioactive Tracers to the Lubrication Industry," by G. M. Leicester, *Scientific Lubrication*, vol. 3, March, 1951, p. 11.

28 "An Investigation of the Flow and Effect of a Cutting Oil in Machining Operations," by W. E. Lauterbach and E. A. Ratzel, *Lubrication Engineering*, vol. 7, 1951, pp. 15–19.

29 "The Effect of the Cutting Fluid Upon Chip-Tool Interface Temperature," by M. C. Shaw, J. D. Pigott, and L. P. Richardson, Trans. ASME, vol. 73, 1951, pp. 45–56.

30 "Effect of Fluids on Tool Tip Temperatures," by J. D. Pigott and L. P. Richardson, *Tool Engineer*, vol. 26, 1951, pp. 35–37.

31 "Coolant Flood Improves Carbide Performance," by W. Iwascheff, *Iron Age*, vol. 168, July 19, 1951, pp. 112–114.

32 "The Application of Cutting Fluids to Machining Operations," by R. B. Niebusch and E. H. Strieder, MECHANICAL ENGINEERING, vol. 73, 1951, pp. 203–207.

33 "Action of Cutting Fluids in Machinery," by M. E. Merchant, *Machine and Tool Blue Book*, vol. 47, 1951, pp. 145-146, 148, 150, 152, 154, 156, 158, 160; *Iron and Steel Engineer*, vol. 27, 1950, pp. 101–107.

34 "Cutting Temperatures and Metal-Cutting Phenomena," by B. T. Chao and K. J. Trigger, Trans. ASME, vol. 73, 1951, pp. 777–793.

35 "The Mechanism of Grinding and the Function of the Lubricant," by J. O. Outwater, *Lubrication Engineering*, vol. 7, 1951, pp. 123-124, 144.

36 "A Study of Heat Developed in Cylindrical Grinding," by R. E. McKee, R. S. Moore, and O. W. Boston, Trans. ASME, vol. 73, 1951, pp. 21–34.

37 "Dynamometer for Torque and Thrust Due to Drilling," by R. C. Brain and H. J. Hulf, *Engineering*, vol. 172, 1951, pp. 487-488.

38 "How to Produce More Holes With Your Drills," by R. J. Sack, *Machinery*, vol. 57, 1951, pp. 143–150, 183–186.

39 "Influence of Lubricants During Cutting of Metals," by N. P. Zhadin, Vestnik Akademii Nauk USSR, September, 1950, pp. 105-106.

40 "Influence of Preliminary Cold Working of Aluminum on Effectiveness of Surface-Active Liquids Applied During Coating," by G. I. Epifanov, Doklady Akademii Nauk USSR, vol. 75, 1950, pp. 415–418, 555–557.

41 "Some Problems Encountered in the Use of Soluble Oils," by A. W. Lindert, *Lubrication Engineering*, vol. 7, 1951, pp. 223–227.

42 "Cold Working of Metals Simplified," by H. C. Knerr, *Metal Treating*, vol. 1, 1950, p. 9.

43 "Sulphide Precoats Facilitate Metal Forming," by J. A. Henricks, *Steel*, vol. 128, February 26, 1951, p. 76.

44 "Cold Extrusion of Steel," by H. Hauttmann, *Archiv für das Eisenhuettenwesen*, vol. 21, 1950, pp. 235–242; translated in *Iron Age*, vol. 167, 1951, pp. 99–104.

45 "Phosphate Lubricant Aids Cold Extrusion of Steel," *Iron Age*, vol. 168, July 26, 1951, pp. 76-77.

46 "Integrated Phosphatizing System Brings Economies in Cold Drawing," *Steel*, vol. 129, July 23, 1951, pp. 71-72.

47 "New Metal Treating Process Speeds Cold Working, Cold Extrusion of Steel," *Materials and Methods*, vol. 34, August, 1951, pp. 68-69.

48 "Phosphate Lubricating Method to Aid Cold Extrusion, Deep Drawing," *Steel Processing*, vol. 37, 1951, pp. 391, 413.

49 "Measurement of Temperature During Bar and Wire-Drawing Operations and the Problem of Supercritical Drawing Speeds," by Walter Reichel, *Stahl und Eisen*, vol. 70, 1950, pp. 1141–1145.

50 "Lubricants for the Cold Working of Non-Ferrous Metals," by S. F. Chrisholm, *Journal of the Institute of Metals*, vol. 78, 1951, pp. 483–500.

51 "Lubricants in Cold Working," by S. F. Chrisholm, *Metal Industry*, vol. 78, April 13, 1951, pp. 283–285.

52 "For Best Forming Results Use the Right Lubricant," by E. L. H. Bastian, *Steel*, vol. 128, May 7, 1951, pp. 116–119, 130, 133.

53 "Rolling Solutions for Specialty Steels," by M. L. Bible, *Iron and Steel Engineer*, vol. 28, June, 1951, pp. 91–93.

54 "Friction in Wire Drawing," by H. G. Baron and F. C. Thompson, *Journal of the Institute of Metals*, vol. 78, 1950, pp. 415–462.

55 "Ringing in Wire-Drawing Dies," by J. G. Wistreich, *Journal of Iron and Steel Institute*, vol. 167, 1951, pp. 162–164.

56 "Ringing in Wire-Drawing," by J. G. Wistreich, *Wire Industry*, vol. 18, 1951, pp. 461, 463, 465.

57 "Metal Drawing Lubricants for Wire, Tubing and Sheet Steel," by W. A. Snigel and H. G. Verner, *Iron and Steel Engineer*, vol. 28, 1951, pp. 97–102.

58 "Friction of Clean Metals and the Influence of Adsorbed Films," by F. P. Bowden and J. E. Young, Proceedings of the Royal Society, series A, vol. 208, 1951, p. 311.

59 "Friction of Diamond, Graphite and Carbon and the Influence of Surface Films," by F. P. Bowden and J. E. Young, Proceedings of the Royal Society, series A, vol. 208, 1951, p. 444.

60 "Surface Welding and the Extreme Pressure Lubricant," by F. I. Finch and R. T. Spurr, ref. (117), p. 79.

61 "Rupture of Oxide Films During Repeated Sliding," by A. J. W. Moore and W. J. McG. Tegart, *Aus. Journal of Scientific Research*, vol. 4, 1951, p. 181.

62 "An Investigation of Surface Damage Using Radioactive Metals," by E. Rabinowicz, ref. (117), p. 82.

63 "Metallic Transfer Between Sliding Metals: An Autoradiographic Study," by E. Rabinowicz and D. Tabor, Proceedings of the Royal Society, series A, vol. 208, 1951, p. 455.

64 "A Study of Metal Transfer During Sliding Using Radioactive Analysis," by E. Rabinowicz, Proceedings of the Physical Society of London, England, series A, vol. 64, 1951, p. 939.

65 "Nature of the Static and Kinetic Coefficients of Friction," by E. Rabinowicz, *Journal of Applied Physics*, vol. 22, 1951, p. 11.

66 "Friction and Surface Damage of Non-Metallic Solids," by F. P. Bowden, *Engineering*, vol. 172, 1951, p. 797.

67 "The Electrostatic Component of the Force of Friction," by R. Schnurmann, ref. (117), p. 62.

68 "An Introduction to Boundary Layer and Extreme Pressure Lubrication," by D. Clayton, ref. (117), p. 25.

69 "Apparatus for the Study by Electron Diffraction of the Effect of Temperature on Surface Films," by J. W. Menter and J. V. Sanders, *Journal of Scientific Instruments*, vol. 27, 1950, p. 335.

70 "Structure of Thin Films of Aliphatic Esters and Alcohols on Metals," by J. V. Sanders and D. Tabor, Proceedings of the Royal Society, series A, vol. 204, 1950, p. 525.

71 "A Study of Boundary Lubricant Films by Electron Diffraction," by J. W. Menter, ref. (117), p. 52.

72 "Orientation of Fatty Acid and Soap Films on Metal Surfaces," by J. W. Menter and D. Tabor, Proceedings of the Royal Society, series A, vol. 204, 1950, p. 514.

73 Discussion by W. Hirst, ref. (117), p. 56.

74 "The Adsorption of Lubricant Films: A Study by Radioactive Tracers," by A. C. Moore, ref. (117), p. 54.

75 "The Lubrication of Rough Steel Surfaces by a Series of Metallic Soaps," by F. T. Barwell and A. A. Milne, ref. (117), p. 44.

76 "The Lubrication of Metals by Long Chain Organic Compounds," by K. V. Shooter, ref. (117), p. 49.

77 "The Boundary Layer," by G. I. Finch, ref. (117), p. 34.

78 "Research on Friction and Wear," by F. T. Barwell, *Engineering*, vol. 172, 1951, p. 649.

79 "Use of Molybdenum Disulphide in Association With Phosphated Surfaces," by F. T. Barwell, *Scientific Lubrication*, vol. 3, September, 1951, p. 10.

80 "Lubrication With Materials in the Solid State," by F. T. Barwell and A. A. Milne, ref. (117), p. 39.

81 "Effectiveness of Molybdenum Disulfide as Fretting Corrosion Inhibitor," by D. Godfrey and E. E. Bisson, NACA Technical Note 2180, 1950.

82 "New Techniques for Measuring Forces and Wear in Telephone Equipment," by W. P. Mason and S. D. White, *Bell System Technical Journal*, vol. 31, May, 1952, pp. 469–503.

83 "Barium Titanate Transducer Capable of Large Motion at an Ultrasonic Frequency," by W. P. Mason and R. F. Wick, *Journal of the Acoustical Society*, vol. 23, 1951, p. 209.

84 "Compliance of Elastic Bodies in Contact," by R. D. Mindlin, *Journal of Applied Mechanics*, Trans. ASME, vol. 71, 1949, p. 259–268.

85 "Effect of an Oscillating Tangential Force on the Contact Surfaces of Elastic Spheres," by R. D. Mindlin, W. P. Mason, T. F. Osmer, and H. Deresiewicz, First National Congress of Applied Mechanics, June, 1951. (To be published during 1952.)

86 "The Rheology of Lubricant Films," by E. W. J. Mardles, ref. (117), p. 7.

87 "The Spreading Behavior and Lubricating Properties of Mixed Liquids," by E. Bielak, E. W. Mardles, and E. Tingle, ref. (117), p. 58.

88 "L'usure en relation avec les regimes du frottement: le frottement sec et les trois regimes du frottement lubrifié," by A. Marcelin, *Mecaniqui*, vol. 34, April, 1950, pp. 139–144.

89 "The Effect of Oil Viscosity on the Power-Transmitting Capacity of Spur Gears," by V. N. Borsoff, J. B. Accinelli, and A. G. Cattaneo, Trans. ASME, vol. 73, 1951, pp. 687–696.

90 "Lubrication at Extreme Pressures With Mineral Oil Films," by O. H. Clark, W. W. Woods, and J. R. White, *Journal of Applied Physics*, vol. 22, 1951, pp. 474–483.

91 "Scuffing Temperatures of Boundary Lubricant Films," by T. B. Lane, ref. (117), p. 35.

92 "Proper Lubrication Lengthens Wire Rope Life," by J. P. Critchlow and R. W. Flynn, *Steel*, vol. 128, June 25, 1951, p. 110.

93 "Static Friction Tests With Various Metal Combinations and Special Lubricants," by H. S. White and D. Zei, *Journal of Research*, the National Bureau of Standards, vol. 46, 1951, p. 292.

94 "The Lubrication of Cotton and Other Textiles," by E. Moss, ref. (117), p. 19.

95 "Self-Lubricating Carbon Components," by A. E. Williams, *Scientific Lubrication*, vol. 2, November, 1950, pp. 10–13, 26.

96 "Symposium on Methods of Measuring Viscosity at High Rates of Shear," by M. R. Fenske, E. E. Klaus, and R. W. Dannenbrink, ASTM Special Technical Publication No. 111, June, 1951.

97 "Symposium on Methods of Measuring Viscosity at High Rates of Shear," by S. J. Needs, ASTM Special Technical Publication No. 111, June, 1951.

98 "Viscosity and Density of Lubricating Oils From 0 to 150,000 Psig and 32 to 425 F," by D. Bradbury, M. Mark, and R. V. Kleinschmidt, Trans. ASME, vol. 73, 1951, pp. 667–676.

99 "Change of Viscosity of Oils Containing High Polymers When Subjected to High Rates of Shear," by L. G. Wood, *British Journal of Applied Physics*, vol. 1, August, 1950, pp. 202–206.

100 "Viscosity of Lubricating Oils at High Rates of Shear," by A. F. Ward, S. M. Neale, and N. F. Bilton, ref. (117), p. 12.

101 "Structural Guides for Synthetic Lubricant Development," by C. M. Murphy and W. A. Zisman, *Industrial and Engineering Chemistry*, vol. 42, 1950, p. 2415.

102 "Functional Selection of Synthetic Lubricants," by R. G. Larsen and A. Bondi, *Industrial and Engineering Chemistry*, vol. 42, 1950, p. 2421.

103 "Chlorotrifluoroethylene Polymers," by W. H. Reinhen and J. D. Gibson, *Industrial and Engineering Chemistry*, vol. 42, 1 p. 2468.

104 "Polymeric Additives for Synthetic Ester Lubricants," by F. J. Glavis, *Industrial and Engineering Chemistry*, vol 42, 1950, p. 2441.

105 "Mode of Action of Phenothiazine-Type Antioxidants," by C. M. Murphy, H. Ravner, and N. L. Smith, *Industrial and Engineering Chemistry*, vol. 42, 1950, p. 2479.

106 "Polyalkylene Glycol Synthetic Lubricants," by W. H. Millett, *Industrial and Engineering Chemistry*, vol. 42, 1950, p. 2436.

107 "Some Industrial Experiences With Synthetic Lubricants," by C. H. Sweatt and T. W. Langer, MECHANICAL ENGINEERING, vol. 73, 1951, pp. 469–476.

108 "Boundary Lubricating Characteristics of Organopolysiloxanes," by C. C. Currie and M. C. Hommel, *Industrial and Engineering Chemistry*, vol. 42, 1950, p. 2452.

109 "Flow Characteristics of Organopolysiloxane Fluids and Greases," by C. C. Currie and B. F. Smith, *Industrial and Engineering Chemistry*, vol. 42, 1950, p. 2457.

110 "Thermal and Oxidation Stability of Polymethylphenylsiloxanes," by C. M. Murphy, C. E. Saunders, and D. C. Smith, *Industrial and Engineering Chemistry*, vol. 42, 1950, p. 2462.

111 "Properties and Performance of Silicone Lubricants," by G. Grant and C. C. Currie, MECHANICAL ENGINEERING, vol. 73, 1951, pp. 311–316.

112 "Non-Catalytic Polymerization of Olefins to Lubricating Oils," by F. M. Seger, H. G. Doherty, and A. N. Sachanen, *Industrial and Engineering Chemistry*, vol. 42, 1950, p. 2446.

113 "Gas Evolution in Liquids and Cavitation," by P. H. Schweitzer and V. G. Szebehely, *Journal of Applied Physics*, vol. 21, 1950, p. 1218.

114 "Catalytic Effect of Several Metals on Oxidation of Lubricating Oils," by D. W. Sawyer, Trans. ASME, vol. 74, 1952, pp. 113–122.

115 "Symposium on Analytical Research in Petroleum Industry," *Analytical Chemistry*, vol. 23, 1951, pp. 1348–1413.

116 "The Friction and Lubrication of Solids," by F. P. Bowden and D. Tabor, The Clarendon Press, Oxford, England, 1950, 337 pp.

117 "Physics of Lubrication," *British Journal of Applied Physics*, Supplement No. 1, The Institute of Physics, London, England, 1951, 96 pp.

118 "Lubrication: Its Principles and Practice," by A. G. M. Michell, Blackie and Sons, Ltd., Glasgow, Scotland, 1950, 317 pp.

119 "Motor Oils and Engine Lubrication," by C. W. Georgi, Reinhold Publishing Corporation, New York, N. Y., 1950, 514 pp.

120 "Metalworking Lubricants," by E. L. H. Bastian, McGraw-Hill Book Company, Inc., New York, N. Y., 1951, 385 pp.

121 "The Practice of Lubrication," by T. C. Thomsen, fourth edition, McGraw-Hill Book Company, Inc., New York, N. Y., 1951, 617 pp.

122 "The Fundamental Aspects of Lubrication," Annals of the New York Academy of Sciences, vol. 53, 1951, Art. 4, New York Academy of Sciences, New York, N. Y., 242 pp.

123 "Third World Petroleum Congress," The Hague, 1951, Proceedings, Section VII, E. J. Brill, Leiden, Holland, 1951, 506 pp.

124 "Physical Chemistry of Lubricating Oils," by A. Bondi, Reinhold Publishing Corporation, New York, N. Y., 1951, 380 pp.

125 "Mechanical Wear," American Society for Metals, Cleveland, Ohio, 1950, 387 pp.

PAPERS LISTED BY TITLE ONLY

126 "Application of the Theory of Effective Loads to the Calculation of Dynamically Loaded Bearings," by A. K. Dyachov (in Russian), Izvestiia Akademia Nauk SSSR Otdelenie Tekhnicheskikh Nauk, No. 11, 1950, pp. 1615–1644.

127 "The Sliding Surface," by G. I. Finch, Proceedings of the Physical Society, London, England, series B, vol. 63, 1950, pp. 465–483.

128 "On the Motion of a High Viscosity Liquid Between Journal and Bearing," by L. M. Fishman (in Russian), Prikladnaia Matematika i Mekhanika, vol. 14, November–December, 1950, pp. 592–610.

129 "Factors Influencing the Scuffing of Gears. A Summary of the Results of Work Done on Gear Scuffing by M.I.R.A. and the I.A.E. Research Department," by R. A. C. Fosberry and H. D. Mansion, The Motor Industry Research Association, Brentford, Middlesex, England, No. 1950/8, July, 1950, 6 pp.

130 "Berechnungen und Modellversuche an Wasser- und Luftlagern," by F. Gottwald and R. Vieweg, (Calculations and Model Experiments on Water and Air Bearings), *Zeitschrift für Angewandte Physik*, vol. 2, November 1950, pp. 437–443.

131 "On the Rolling Friction," by Taro Hisada and Kozo Tugawa, *Journal of the Mechanical Laboratory*, vol. 4, Special Number, March, 1950, A.I.S.T. Sumioshicho Suginami-ku, Tokyo, Japan, pp. 9–22.

132 "The Variation of the Coefficient of Static Friction With the Rate of Application of the Tangential Force," by R. C. Parker, W. F. Farnworth, and R. Milne, I.M.E. Applied Mechanics Proceedings, vol. 163, 1950, W.E.P. No. 59, pp. 176–184.

133 "The Efficiency of Planetary Gear Trains," by R. Poppinga (in German), *Glaser's Annalen*, vol. 74, 1950, pp. 139–145; *Engineers' Digest*, vol. 11, 1950, pp. 421–425.

134 "Bestimmung der Wärmeleitfähigkeit und spezifischen Wärme verschiedener Mineralöle," by L. Riedel (Determination of Thermal Conductivity and Specific Heat of Mineral Oils), *Chemie-Ingenieur-Technik*, vol. 22, March 14, 1950, pp. 107-108.

135 "A Problem in Lubrication," by M. Rothman, *Journal of the Royal Technical College*, Glasgow, Scotland, vol. 5, January, 1950, pp. 1–5.

136 "Theory of Hydrodynamic Lubrication of Plane Slider and Full Journal Bearings With Side Leakage," by T. T. Wang (in Chinese), Engineering Reports, National Tsing Hua University, vol. 4, 1950, pp. 96–106.

137 "A Contribution to the Hydrodynamics of Lubrication," by G. H. Wannier, *Quarterly of Applied Mathematics*, vol. 8, April, 1950, 32 pp.

MANPOWER UTILIZATION *and* NATIONAL SECURITY

A Statement by the Engineering Manpower Commission of Engineers Joint Council

By CAREY H. BROWN

CHAIRMAN, EJC ENGINEERING MANPOWER COMMISSION. MEMBER ASME

EVERY citizen shares the universal obligation to serve his country. The type of service he can best render depends upon his abilities and limitations, his talents and training. For the best interests of the nation, each person should serve where he can serve best and up to the limit of his abilities and capacity. This concept demands service, not only in uniform, but also in those activities that must be maintained to support the national economy. Such activities include agriculture, defense, and other essential production, transportation, communications, medicine, education, government, and others, required in the national health, safety, and interest.

Today our nation faces an indefinite period of partial mobilization. In addition to a shortage of manpower within the age brackets considered suitable for military service, the mobilization is further complicated by a dearth of technical and scientific manpower to satisfy the needs of the military forces and of other essential activities. Because of the low birth rate during the depression years of the 1930's, we are faced with a decreasing number of young men reaching age 18 each year. This decrease will continue through 1953 and the trend will not be reversed until 1956.

During frontier days all citizens accepted the necessity of bearing arms to defend their homes. Generally the periods of defensive action were of relatively short duration and the action was local in character. The call to arms caused little interruption of the essential production needs of the community.

Today the situation is different. It cannot be met with the response or philosophy of frontier days. Our essential needs are more complicated and diverse, largely because of the change from an agricultural to an industrial economy and of the higher standard of living which is the product of industrial development. Requirements for defense are likewise far more complicated and diverse. The scene of action is no longer local. The weapons and equipment of the modern fighting man are complex. The development and production of better weapons and equipment requires a higher and higher level of engineering and scientific skills, especially in research and development activities.

We are now far more dependent individually upon the productive efforts of others than were our forebears. We must provide manpower to support the civil economy as well as the military effort. Interruption, or serious reduction, of industrial activities because of a policy which would remove an essential group therefrom to render extended service in uniform, may have grave consequences. It could easily seriously reduce the development and production of the very equipment needed most by our military forces.

Security of this country is not a question of uniformed manpower alone. It is equally a question of ability to produce goods and equipment, not only for the military forces, but also for that part of the civilian economy which is essential to our continued existence. Our potential enemies greatly outnumber us on a man-for-man basis. Study shows that wars are not won by sheer superiority in the numbers of fighting men, or by prewar military training or service alone. They are won through superior equipment and productive capacity.

Germany and Japan provide excellent examples of the effectiveness of superior equipment over preponderance of manpower. In the beginning of World War II and during the invasion of China, both countries were successful, mainly because of the quality and quantity of their equipment advantage. True, they had a certain manpower advantage too, but when the weight of Allied equipment exceeded that of Germany and Japan, the fortunes of war turned against the latter. From the beginning of time, examples may be found to illustrate that superior equipment wins over mere manpower superiority—David's slingshot, the English long bow at Agincourt, and Napoleon's artillery, to name but three.

Not only must we develop and produce superior weapons, but we must maintain the sound economy essential to continued productive capacity if the man at the front is to be effective. These requirements are part of an inseparable whole in maintaining the security of our nation.

With the balance of manpower supply in favor of our potential enemies, it is of the utmost importance that we make the most effective use of what we have. This utilization is not merely a problem of furnishing men in uniform for military service. It also involves a co-ordinated plan for strengthening productive agencies—designing and developing equipment to continually improve our standards of living and ability to produce; designing and developing better equipment for defense.

Any successful program of defense must take into account that the survival of the United States as a free nation will depend on *superior scientific and engineering skills* to offset the superiority in numbers of men which free nations lack. In addition to an over-all deficit in numbers for our military forces, we are faced with a critical shortage of persons having specialized skills and experience, especially in the fields of engineering and science. A basic consideration is the necessity for training and developing the specialists we need in the future—engineers, scientists, diplomats, doctors, farmers, professional military personnel. We must not repeat the mistakes we made in World Wars I and II when training for civil pursuits was, to a major extent, suspended to meet the emergency of the period. We must realize that we now face a situation of indefinite continuance, not a brief or transient one.

Presented at the Conrad Hilton Hotel, Chicago, Illinois, September 7, 1952, in connection with the Centennial of Engineering.

Should there be all-out war, the requirements of the Armed Forces will be great. It may be assumed that every physically fit young man is destined to serve in uniform, *unless it can be shown by clear and convincing evidence that he can serve the nation to better advantage in industry, agriculture, or some other pursuit which vitally affects the national health, safety, and interest.*

The policy which we advocate would involve withholding from the total pool of men of military age, presently numbering 10,000,000 physically fit between the ages of 18 and 30, only those of the highest technical and professional qualifications, and reasonable numbers of trainees to attain such qualifications. The screening procedure will involve selection of the very highest order and must be conducted with great care if public confidence is to be maintained. This policy would require the deferment of about 500,000 young men, or 5 per cent of the age group in question. This 500,000 constitutes a segment critical to present and future technical superiority. Otherwise, the requirements for technical manpower must be met out of the pool of older men, women, 4F's, and underage persons, and the flow of younger men into technical fields will be interrupted. The young engineer is in many cases equally in demand, sometimes even more than his more experienced confrere, for much of the technology now critically important is so new that only recent students have any training whatever in its application. A belief that the technical requirements of industry can be met by men generally over military age—even if there were enough of them—is therefore a fallacy.

NATIONAL MANPOWER MOBILIZATION POLICY

A National Manpower Mobilization Policy was promulgated by the President on Jan. 17, 1951. This statement enunciated the principle: "*each individual will be expected to serve in the capacity in which he can contribute most to the total mobilization program.*" It provided for fulfilling manpower requirements not only for military purposes but also for the maintenance of a strong domestic economy, and the provision of materials for essential needs, both military and civilian. It is a basically sound policy.

However, it is evident that this policy has not been fully followed by the various executive branches of the Federal Government as the underlying basis for their procedures. In the call-up of reserves, and in the disposition of individuals after call-up, the military departments seem to give first consideration to numbers and to availability rather than to qualifications. Inadequate weight is given to the role of the individual in the essential civilian economy in determining whether or not a man should be called for military service. ROTC graduates are subject to call in substantial disregard of their individual qualifications or of their contributions in nonmilitary capacities. In the Services, the individual's military duties are primary and the utilization of his specialized skills is secondary. This permits highly inefficient use of uniformed personnel having special skills, even in those technical branches of the Service which are, at the same time, determinedly recruiting civilian engineers and scientists.

The Engineering Manpower Commission of Engineers Joint Council strongly recommends that every effort be made by all agencies of industry and government to follow implicitly the principles delineated in the National Manpower Mobilization Policy. It recommends further that in the development of a program for manpower utilization in relation to national security, more consideration be given to the value of building the potential for production of essential equipment for the Armed Forces. This is of far more importance in providing for the successful defense of the nation than is the mere build-up of numbers of military personnel. In general, it is much simpler to procure and train men for military service than it is to train men for the expansion of industrial capacity.

DEFINITIONS

In order to clarify the following discussion, it is well to outline the meaning or significance placed upon terms used to designate the various patterns proposed for manpower utilization.

(1) *UMT, Universal Military Training*—a term applied to any of several plans for *training* our physically fit manpower. The plan submitted to Congress by the National Security Training Commission called for the induction of young men at age 18 for six months' training. At the end of their period of training they would be placed in a reserve component for an obligated service in the reserves of 7½ years. The predominant feature of UMT plans is a period of *military training followed by an obligated period in a reserve component.*

(2) *UMS, Universal Military Service*—a term applied to any of several plans providing for an obligated period of *active military service.* The basic plan for UMS proposed that *all* physically fit men be placed in active service for two years commencing at age 18. Variations of this plan have been suggested to permit the period of service to be postponed for educational purposes, but only until graduation or cessation of training. The predominant feature of UMS plans is a period of *compulsory service in uniform for all physically fit men without regard to the occupation, capabilities, or training of the individual, or the probability that he might best serve the nation elsewhere.*

(3) *Selective Service*—a term applied to the plan established by law for *selecting* from those who have military service liability: (1) those who are to enter military service in accordance with the needs of the Armed Forces, and (2) those with special skills who are to continue to serve in the essential economy including defense industry. The predominant feature of Selective Service is the *selection of manpower for service in accordance with both need and skill.*

UNIVERSAL MILITARY TRAINING

Most informed persons agree that for many years to come, the United States and its allies must maintain a substantial degree of preparedness. Some venture the opinion that preparedness must continue at approximately the present level for a period of twenty years; others believe as long as fifty years. If we continue to maintain 3,700,000 men in uniform, on the basis of present population distribution, about three years' service will be required of each physically fit young man either before or after his college or other training.

In an emergency of such long duration it seems advisable to establish by law the obligation of all persons to train for the defense of the nation and to defend it in time of emergency. The training phase should be universal and should exclude only those who are physically unable to take any training, military or otherwise. It should be so timed as to interfere to a minimum degree with the education or employment of the young men concerned.

After training, the trainee will normally pass into a reserve from which he will be subject to call in event of emergency. Governing such recall, there must be a system of selection which will either call the man for military service or defer him in the national interest if his retention in civilian life is essential to the national health, safety, and interest

In considering the necessity for training, we must not lose sight of the fact that until recently, we have been relying largely upon those who comprised the Armed Forces in World War II. This is demonstrated by our Korean experience when it has been necessary to recall combat veterans of World War II for the build-up of the Armed Forces. The veteran segment of the reserve is diminishing every day, because the men and

women are getting older, are acquiring physical disabilities or a dependency status; or other situations tend to make them less available for military service. While men cannot be trained in substantial numbers while the entire pool is drained for immediate service, as at present, we should move at the earliest possible moment in the direction of training our young men and creating a continuing reserve, if the nation is to be secure.

The Engineering Manpower Commission of Engineers Joint Council recommends that a practical plan for Universal Military Training be developed and enacted into law. Provision should be included to implement the reduction of our standing Armed Forces so that the training of our young men and the creation of a continuing reserve through UMT can commence as early as practicable.

UNIVERSAL MILITARY SERVICE

Many plans have been proposed involving some form of Universal Military Service, i.e., service in uniform for *all* in a stipulated age bracket, except for those not physically fit. Modifications have been proposed to permit the period of service to be postponed for students satisfactorily pursuing courses of higher education. Other modifications suggest deferment of apprentices, or the assignment of men for compulsory service as civilians in military research and development. Generally the proposals stress a universal obligation to serve *in uniform* as being "democratic," and as such, essential to the American way of life. Actually, service at the highest capability, whether in uniform or out of uniform, would seem to be the most desirable goal.

Should Universal Military Service be adopted, there would be a suspension in the output of engineering and scientific graduates, other than the physically unfit, needed to serve in industry, of new agricultural manpower needed for our economy, and of new teachers and educators also sorely needed. This suspension would last for two or more years under presently proposed plans. In view of the current shortages in specialized fields, we cannot afford suspension for such a period. It furthermore seems likely that the interrupted training represented by military service of such length will make the integration of these young men into industry more difficult and thus, in effect, add to the period of loss of their services.

The Engineering Manpower Commission of Engineers Joint Council, as has been stated, is in favor of a *selective* system which will co-ordinate the manpower needs of the military with the manpower requirements of essential industry, including the production of more and better equipment for defense. For this reason we are opposed to Universal Military Service as being prejudicial to national security.

SELECTIVE SERVICE

The Selective Service System as presently constituted has been operating not only to select people for induction into military service but also to select those for retention in the essential civilian economy.

In the fields of medicine and agriculture, the various local boards and state directors of the Selective Service System have state and county boards and committees to advise them with regard to personnel selection in these fields. In the case of medicine, requests for doctors, dentists, veterinarians, and allied skills are actually submitted to the County Medical Boards for filling rather than to the Selective Service System. The County Medical Boards are in a position to designate those doctors who can best be spared to fulfill the requirements of the military services.

In the case of agriculture, state and county Agricultural Mobilization Committees have been organized under the administration of the Department of Agriculture. These committees provide facts to assist the local boards and the state directors in the Selective Service System with respect to classification of registrants in this field.

No provision exists to cover such advisory service at local and state levels, either to the Department of Defense or to the Selective Service System, in other specialized fields such as engineering, the sciences, and education. As a consequence, many local boards do not have sufficient facts to make a wise and just selection in the over-all interests of national security. The Engineering Manpower Commission of Engineers Joint Council recommends that the Selective Service System be strengthened to provide advisory services to the local and state boards for such specialized personnel through state and county advisory committees, composed of representatives of industry and the specialized professions. These committees will provide advice with respect to such personnel comparable to that now furnished in the fields of medicine and agriculture.

ARMED FORCES RESERVE

On July 9, 1952, the Armed Forces Reserve Act of 1952 (P.L.-476) became law. In addition to providing some uniformity in the over-all administration of the reserve components, this act establishes a Ready Reserve, a Standby Reserve and a Retired Reserve. The Ready Reserve is that portion liable to immediate recall. It is limited by the Act to 1,500,000 men, including the National Guard. The Standby Reserve includes all other reservists liable to recall but not necessarily immediately. The Retired Reserve, as its name implies, contains those reservists who are retired but may be recalled for limited duty in the event of war.

The Ready Reserve will actually contain that segment of trained reservists and units needed for an immediate mobilization effort in the event of national emergency declared by the President, or police action such as that in which we are now engaged in Korea. Outside of the National Guard and Air National Guard, it is most probable that the Ready Reservists will be called as individuals to bring the cadre of existing service units to full mobilization strength.

The Standby Reserve will contain all other reservists except those on the retired list. Within the Standby Reserve, however, there will be the active organized units which will be required in the event of total mobilization or war as declared by the Congress. The Standby Reserve thus will be similar to the Reserve as maintained before the passage of P.L.476.

Notwithstanding testimony before the Senate Armed Services Committee by the Engineering Manpower Commission of Engineers Joint Council and others urging provisions for the *selective* recall of reservists (which testimony, we thought, was well received) the Armed Forces Reserve Act of 1952 was passed without such a safeguard. Therefore we feel that it does not provide for the best utilization of manpower in the national health, safety, and interest.

Section 4 (*d*) of the Universal Military Training and Service Act (P.L.51) provides for a total period of liability of eight years of active training and service in the Armed Forces and in a reserve component for all persons below age 26 who are inducted, enlisted, or appointed after June 19, 1951. It established, for the first time in our history, a compulsory reserve. It is evident that eventually practically all of the able-bodied young men below age 26, or older, except for those making a professional career in military service, will be in a reserve component of the Armed Forces to complete their term of liability, and thus subject to recall.

By the time they are recalled to active military service, many members of both the Ready and Standby Reserves will have acquired specialized skills and experience that would make their recall detrimental to the total defense effort. These

are the persons who should be identified by a careful classification and selection process in order that the needs of defense industry and the essential civilian economy will not be seriously hampered by their recall to active duty.

Some provision must be included in the law, therefore, to conserve reservists having specialized skills and experience when their service in a civilian capacity would contribute more to the national strength and security than their service in uniform. Reservists who do not have an obligated period of service should be discharged. Reservists who have an obligated period of service should be transferred to an inactive status list from which they would not be called or from which their recall could be governed by a civilian agency or board outside the military departments. This civilian governing board should have the authority to render final decisions. It should be composed of representatives of the Department of Defense, various other governmental departments, the professional groups involved, and the military departments.

The civilian governing board would be the top board at the national level. In order to maintain public confidence and to reduce the volume of individual cases which would otherwise have to be reviewed at the national level, local and/or state boards should also be organized. The local and state boards should be composed of representatives of the professional groups involved and of the military departments. They should, however, remain civilian in character and have authority to render decisions within the framework of criteria established by the national board.

In order to reduce to a minimum the problems which would be encountered in a full-scale mobilization, there must be a continuing appraisal of the classifications of reservists to insure to the maximum possible extent that those who have specialized skills and experience are properly classified before mobilization takes place.

Some provision must also be included to insure the continuance of the education and training of specialists needed in the future. Students who are pursuing professional and scientific courses in the colleges should be permitted to complete their study before being considered for recall to active duty. Many of them will be needed by the technical branches of the Armed Forces as well as in other essential activities of the national economy.

The Engineering Manpower Commission of Engineers Joint Council, therefore, recommends that the Armed Forces Reserve Act (P.L.476) be amended accordingly.

ROTC

Because of impending military service there has been a greatly increased enrollment in ROTC units by students entering the colleges. In a large measure this may be attributed to the assurance of completing their college education without disturbance and of receipt of commissions on graduation.

In the past when students enrolled in the Air or Army ROTC, they had the privilege of applying for two years of advanced training *after completing two years of basic training*. Students who were enrolled in the Naval ROTC, however, were obliged to complete four years of training. Enrollment in advanced Air or Army ROTC courses therefore, until this year, has been optional on the part of the student.

With the current operation of Selective Service there has been increasing pressure exerted by the ROTC officers to have all students in the ROTC sign draft deferment agreements. These draft deferment agreements commit the student to the completion of four years in ROTC and acceptance of a commission, two years' active service upon graduation, and six years' additional service in a reserve component.

A recent survey made in the engineering colleges revealed that 16 per cent of the seniors of the class of 1952 were commissioned as a result of ROTC training as compared with 11 per cent of the previous year's graduates. Examination of the enrollments in ROTC in the *undergraduate* classes, however, shows that 23 per cent of the juniors are so enrolled, 45 per cent of the sophomores, and 55 per cent of the freshmen.

The survey from which these figures were obtained was made by the Engineering Manpower Commission in May, 1952. It covered returns from 174 out of a total of 192 engineering colleges in the United States. It is evident from this that an increasing number of engineering graduates each year will be committed to a period of service sufficiently long to hamper the needs of essential industry unless provision is made for their selective withdrawal from service liability.

To add to the problem, it has been decided, beginning this year, to convert Army and Air ROTC units to Branch General training and to discontinue curricula in the technical specialties. Upon graduation, assignments will be made to the various branches, technical and combat, in accordance with the requirements of those branches, and the training and standing of the students. The advocates of this change state as a primary advantage that it trains cadets essentially for combat and makes it possible for the Army and Air Force to obtain a larger percentage of combat officers.

The Engineering Manpower Commission heartily supports the general ROTC concept that American colleges and universities should be utilized for the purpose of training reserve officers, especially those needed in the technical branches of the service. We feel, however, that proper utilization of graduates having special training such as in engineering and science, may indicate that officers for the technical branches of the service should be obtained through the ROTC, and combat officers through Officers Candidate Schools. We therefore recommend that further study be given to the ROTC program, especially with respect to the effects on manpower utilization of the trend toward Branch General training.

We recommend also that new criteria be established in choosing students for ROTC programs in order to assure a more equitable distribution between civilian and military needs. The present method channels into ROTC units a disproportionate share of students capable of and needed for graduate training and for other essential activities. Realistic quotas should be established in the various military categories, and every effort should be made to restrict the entrants to accord with such quotas and to match their fields of specialization.

Reservists who are ROTC graduates should be subject to the same screening, classification, and selective recall as has previously been recommended for reservists in general in the proposed amendments to the Armed Forces Reserve Act.

We also recommend that Selective Service regulations be modified to permit students in engineering, science, and other critical fields to receive the same assurance of completing their education as is now provided to those enrolled in the ROTC units.

UTILIZATION OF PERSONS HAVING SPECIALIZED AND CRITICAL SKILLS

Concurrently with the universal obligation of each man and woman to furnish his best service in maintaining the national security is an obligation on all agencies—military and nonmilitary alike—to utilize manpower in such manner that the most proficient service can be furnished. This is especially true with respect to those persons possessing critical and specialized skills in short supply.

The present shortage of engineers and scientists is serious because of its effect on the national economy and on national security. If we do not utilize our limited manpower effectively, we will lose technological superiority over our probable ene-

mies. With such loss, the probability of a full-scale war with the forces of communism will become infinitely greater.

The Engineering Manpower Commission of Engineers Joint Council urges in the national interest that the following steps be taken:

(1) *Military Utilization*

(*a*) Establish manpower budgets for engineers and scientists in each activity, in accordance with actual needs for their professional skills and experience. A catalog of requirements is vital as the first step toward maximum utilization of the total supply.

(*b*) Eliminate confusion in the distinction between a ***professional engineer*** and a ***technician*** by discontinuing references in billet designations, military occupational specialties, and elsewhere, to the word ***engineer*** except where the position requires an engineering graduate or scientist. Re-examine those enlisted billets which now apparently require an engineering graduate or scientist to determine whether the billet cannot be filled by a competent technician. Technicians can be trained in a matter of months; the professional engineer or scientist is the product of at least four years of full time study coupled with more years of development and experience.

(*c*) Recall engineers and scientists to active duty only to the extent they can be ***fully*** used in their specialties.

(*d*) Provide for commissioning in their specialties all engineering graduates and scientists who are inducted through Selective Service, or who are enlisted reservists, to permit full utilization of their skills.

(*e*) Provide for interservice transfers of persons having special skills in order to provide a wide base of utilization of their skills. For example, this would permit the transfer of aeronautical engineers or meteorologists, when needed, from the Army to the Air Force or to the Navy.

(*f*) Provide for the release from active duty of those engineers and scientists not needed as such.

(2) *Civilian Utilization* (including utilization in government, agriculture, transportation, manufacture, and all other activities outside of the military).

(*a*) Establish manpower budgets similar to those recommended for the military.

(*b*) Study the duties, and the proportionate time spent on each duty, of engineers and scientists, in order to transfer to supporting personnel those duties not requiring full engineering or scientific skills. Many such duties can be performed equally well, if not better, by technicians, clerks, draftsmen, and others. Do not hire engineers or scientists for positions in which their skills are not required.

(*c*) Move engineers and scientists from positions not requiring professional engineering or scientific training.

(*d*) Move engineers and scientists to positions of maximum responsibility as rapidly as possible in accordance with need, ability, and experience.

(*e*) Do not hold engineers or scientists in "intern" or training positions longer than necessary to qualify them.

(*f*) Maintain salary differentials between senior engineers and scientists and those newly graduated. Competition for new graduates has resulted in unprecedented levels of starting salaries.

SUMMARY OF RECOMMENDATIONS

In the interest of national security the Engineering Manpower Commission of Engineers Joint Council recommends that:

(1) All segments of our economy, governmental and non-governmental alike, follow implicitly the principles delineated in the National Manpower Mobilization Policy promulgated by the President on Jan. 17, 1951, in their procedures and programs for manpower mobilization and utilization.

(2) In the development of programs and plans for national security more consideration be given to the value of building the productive potential and a co-ordination be effected between this and our manpower needs. Greater productive facilities are of far more importance in providing for the successful defense of the nation than is the build-up of military forces during times of peace or partial mobilization.

(3) A practical plan for Universal Military Training be developed and enacted into law. Provisions should be included to reduce our standing Armed Forces as early as practicable so that the training of our young men and the creation of a continuing reserve through UMT can be commenced.

(4) Plans for Universal Military Service as presently proposed be abandoned as unsound and prejudicial to the national security.

(5) The Selective Service System be strengthened to provide advisory service to local and state boards with respect to professional and specialized persons. Such advisory services should be provided by county and state boards, composed of representatives of industry and the professions, to furnish competent advice with respect to the essentiality in the national security of certain civilian services, and the specific value of the individual who is subject to induction based upon his specialized and critical skills.

(6) Selective Service regulations be modified so that college students in engineering, science, and other critical fields may be given the assurance of being able to complete their education before being inducted, in the same manner as is now done for those enrolled in ROTC programs.

(7) The Armed Forces Reserve Act of 1952 be amended to provide for the creation of a Civilian Reserve Governing Board, outside of the military departments, to establish criteria for, and render final decisions with respect to, the classification and mobilization assignment of reservists having specialized skills and experience, and to maintain a continuing process of classification of such reservists.

(8) The Armed Forces Reserve Act of 1952 be amended to provide for the creation of local and state Civilian Reserve Boards operating under the Civilian Reserve Governing Board to render decisions at the local level with respect to the classification, mobilization assignment, and delay in recall to active duty of reservists, within the framework of the criteria established by the Civilian Reserve Governing Board.

(9) The Armed Forces Reserve Act of 1952 be amended to provide for the continued training of professional and scientific personnel without interruption.

(10) The present trend in ROTC units toward providing only Branch General training and discontinuing technical curricula be re-examined in the light of its effect on utilization of those with special and critical skills.

(11) New criteria be established for choosing students for ROTC programs to insure distribution of graduates between military and civilian agencies on a basis which will better satisfy national needs.

(12) Realistic quotas be established for the various ROTC programs and entrants be restricted within these quotas and in accordance with needs for their fields of specialized training.

(13) All segments of our economy, governmental and non-governmental alike, take specific steps toward full utilization of persons possessing critical and specialized skills in short supply in the best interest of the country as a whole rather than in their special interest. To this end, it is important that budgets of specialized manpower needs be established, and that the duties performed by specialized persons be thoroughly studied in

(*Continued on page 908*)

THE ASME BOILER CODE

IV ASME Expands the Boiler Code—1919–1924

By ARTHUR M. GREENE, JR.

PRINCETON UNIVERSITY, PRINCETON, N. J. HONORARY MEMBER ASME

THE 1918 Edition of the Code was approved in December of that year. It resulted from many revision sessions of the Committee during the previous two years at which the minutes of the public hearing of December, 1916, and the interpretations formulated during a four-year interval were consulted. Changes suggested by the public hearing and the interpretations and also those suggested by subcommittees and by persons or groups called before the Boiler Code Committee were included in this revision which became the 1918 Edition. To aid Committee members at their meetings and those attending the hearings of 1916, the inquiries and replies on Cases 1 to 114 were published in October, 1916; and in September, 1917, those on Cases 1 to 172 were issued in a single pamphlet.

1918 EDITION OF THE CODE

The new edition had the same arrangement and paragraph numbering as were used in the 1914 Edition: Part I, Section I, New Installations of Power Boilers, Section II, Low-Pressure Heating Boilers; Part II, Existing Installations. Although the arrangement of subjects and the paragraph numbering were the same as in the first Code, the wording was changed to meet the interpretations, suggestions, reports, and results of investigations by members of the Boiler Code Committee or by subcommittees. Many meetings were spent in considering reports and hearings of representatives of industry.

New tables for the gages of water tubes of Par. 21 with the formulas pertaining to them replaced the former empirical table which had been developed from experience up to 1914 with steam pressures of that day. These were formulated after study by a committee consisting of D. S. Jacobus, S. F. Jeter, and Wm. F. Kiesel, Jr. The method of finding the allowable pressure on fire tubes when the gage was increased beyond that for 175 psi was added to Par. 22.

Many specifications for Materials of the 1914 Code were brought into agreement with those of the American Society for Testing Materials, by the action of the subcommittee appointed to confer with a similar committee of that society.

A number of changes were made in the paragraphs on boiler joints. These changes resulted from interpretations, and Par. 186 was changed to allow autogenous welding "where the stress or load is carried by other construction which conforms to the requirements of the Code and where the safety of the structure is not dependent upon the strength of the weld."

Par. 193 on the determination of the efficiencies of the longitudinal and diagonal ligaments of shells or drums was entirely new and required the use of a new chart for its application. It had resulted from an extensive study of strains made by Dr. D. S. Jacobus and his associates of the Babcock and Wilcox Company. Changes were made in the paragraphs referring to domes, heads, braced and stayed surfaces, as well as stays, stay bolts, braces, and connections. Fig. 20 showing the acceptable forms of rivet heads was added.

The allowable working pressure with malleable-iron headers was increased from 160 psi to 200 psi because of the improvement in the manufacture of such material. The test pressure at destruction on structures of this material was increased from 1200 psi to 1500 psi.

The section on safety valves was altered to meet only the earlier criticism by the safety-valve manufacturers as they failed to offer any comments on the proposed section when first issued for criticism. Some minor changes were made in the paragraphs dealing with water and steam gages, fittings and appliances, and piping and methods of support.

The requirements for stamping and data reports were changed to meet the experiences which came from the administration of the 1914 Code.

Section II of Part I on low-pressure steam and hot-water heating boilers and hot-water supply was changed to cover only the interpretations, as the full discussion requested from the National Boiler and Radiator Manufacturers Association had not been presented by that association.

Part II, Existing Installations, was practically the same as that of the 1914 Code although a new paragraph was added requiring consultation with a state inspector, municipal inspector, or inspector of a boiler insurance company when repairs affecting the working pressure or safety of the boiler were needed. The "Recommendations for Repairs When Made by Welding and Reinforcing by the Electric, Oxy-Acetylene, or Other Process" prescribed by the Board of Supervising Inspectors, U. S. Steamboat Inspection Service, were given in the Appendix.

The Appendix contained the same material on the efficiency of riveted joints that was used in the earlier Code, with the omission of one form of complex joint, and the addition of one section on braced and stayed surfaces. Fig. 32 on details of stays for the application of Pars. 205 and 206 was added. A method of calculating the discharged capacities of safety valves, as well as the American Standards for Flange Fittings, and data on fusible plugs were also added. The Appendix included new parts relating to automatic water gages and repairs by welding.

A complete index of 15 pages was added at the end of the 1918 Code.

This 1918 Code was formulated during World War I when proper materials were scarce. During this period, the Committee refused to allow its requirements for safe materials and practices to be lowered. At all times it was willing and ready to accept changes in the Code when such changes did not affect safety.

The introduction to the Code, which outlined a statement of its object and method of administration and described the changes that had been made in the 1914 Code and the reasons for them, was signed by the 24 members of the Boiler Code Committee and the thirteen members of the Conference Committee. The business connection of each member of the

---

Chapter 4 of a history of the ASME Boiler Code, prepared for the Boiler Code Committee of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Chapter 1, which dealt with the antecedents of the Code, appeared in MECHANICAL ENGINEERING, July, 1952, pp. 555–562; Chapter 2, which told how ASME set up the Committee and adopted the first Code of 1914, appeared in August, 1952, pp. 640–646; and Chapter 3, which dealt with the administration of the first Code from 1915–1918, appeared in September, 1952, pp. 727–734.

Committee and the state or municipality represented by each member of the Conference Committee appeared with each name. The Conference Committee members represented California, Minnesota, New Jersey, New York, Ohio, Pennsylvania, Wisconsin, Allegheny County, Pa., Detroit, Mich., Erie, Pa., Kansas City, Mo., Philadelphia, Pa., and St. Louis, Mo. On the list of Code Committee members E. R. Fish replaced the late Col. E. D. Meier and Fred R. Low replaced Carl Ferrari. The place of the late H. G. Stott had not been filled.

CODE COMMITTEE ORGANIZATION

In January, 1919, there were subcommittees on Boilers of Locomotives, Heating Boilers, Welding, Strength of Cast Iron Boilers, Rules of Inspection, and Care of Boilers in Service, as well as two Conferring Committees, one with ASTM and the other with the Massachusetts Board of Boiler Rules.

Subcommittees, as described earlier, were composed of designated members of the Boiler Code Committee and nonmembers whose experience and interests were of particular value to the activities of the subcommittees. Certain subjects were referred to other special committees for reports at intervals, and these committees ceased to function when their work was completed.

An Executive Committee acted on special matters referred to it and on emergency questions that arose between meetings of the Boiler Code Committee.

During the period from 1919 to 1924, the Committee met nine times a year, usually for one day, although at revision times in 1923 and for special hearings two-day sessions were required. The average attendance of the 23 Committee members was 11, while that of the 13 members of the Conference Committee was only 4. The average attendance of the non-Code Committee members of the subcommittees was 3, and on an average 5 persons were invited to attend to give advice or to explain devices or constructions on which they desired rulings or interpretations.

The number of new cases considered during this six-year period, 1919 to 1924, from Case 209 to Case 471, averaged 44 per year. At each meeting of the Committee old cases were revised (after objection had been made in the criticisms by some members), reopened, annulled, or held over, and replies were formulated for new cases or they were held for study by designated members of the Boiler Code Committee or by the Executive Committee. After ASME Council approval of the 1924 Edition on March 16, 1924, the Boiler Code used some earlier interpretations as replies to new cases until its meeting of Sept. 15–16, 1924, when it decided to make no further reference to interpretations of the 1914 and 1918 Editions but to base all replies on the 1924 Edition, annulling all previous cases.

Between 1919 and 1924, cases were presented by manufacturers of boilers or appliances, state officials, insurance representatives, engineers, designers, and users as in previous periods. When a case required a reply which was an interpretation establishing a precedent or called for addenda or amendments, it was given a case number following those previously assigned after full information with the necessary drawings had been presented to the Boiler Code Committee. When, however, the inquiry was of sole interest to those submitting it, it was treated as a communication, as formerly, to which a letter of reply was formulated by the Committee. This reply as well as any reply to a case was subject to the approval by letter ballot of all members of the Committee.

TESTS TO DESTRUCTION

Although by interpretation the Boiler Code Committee had enlarged Par. 247 for tests to destruction to refer to structures as well as to the cast-iron headers of this paragraph of the 1914 Code, only one of the designers to whom tests were suggested for the determination of the allowable working pressure had availed himself of it. This interpretation was the basis of the altered Par. 247 in the 1918 edition of the Code. It called for a full-sized sample to be built and tested to destruction by the manufacturer in the presence of the Boiler Code Committee or one or more representatives of the Committee appointed to witness such test.

The Page Boiler Company of Chicago, Ill., requested a test of a particular form of boiler construction for which no method of reliable calculation of allowable working pressure was known. Their request for a test was reported on Jan. 17, 1920 and Wm. H. Boehm was appointed to represent the Committee on Feb. 26, 1920. This test was witnessed by his representative and as the test showed that the semisteel boiler header did not meet the specification for steel or malleable iron, the header limited the boiler pressure to 160 psi.

The Bigelow Company of New Haven, Conn., asked for a test of one of its water-tube boiler units. The test of March 20, 1920, was reported on April 22, 1920, by S. F. Jeter of the Boiler Code Committee. The test indicated that the construction should be suitable for a working pressure of 300 psi.

At the meeting of March 22, 1923, the test of another section of a boiler of the Bigelow Company was reported by S. F. Jeter and V. M. Frost of the Boiler Code Committee which indicated that 360 psi could be allowed on this section. As this was not sufficient for the proposed use of this boiler, the company later requested a test on a modified section and A. M. Greene, Jr., W. F. Kiesel, Jr., and Wm. H. Boehm were designated to witness a test on the improved section. On April 26, 1923, the test of this section was made in the presence of V. M. Frost, W. P. Eales, and Wm H. Boehm as Messrs. Greene and Kiesel could not attend. The test was continued up to 1100 psi with no pull-out of tubes. A most complete report with full test data and curves showing where permanent set occurred indicated that the section could be allowed a working pressure of 380 psi.

E. C. Fisher reported at the meeting of May 24, 1920, that he had witnessed a test on a cast steel water box of the Green Engineering Company of East Chicago, Ill., and on the basis of his complete report this box was considered to be safe for a working pressure of 250 psi.

Wm. H. Boehm and M. S. Miller reported to the Boiler Code Committee, Jan. 11, 1924, on the test of a welded-steel nozzle built by the M. J. Dougherty Company of Philadelphia. The report made by Mr. Miller gave a full description on the construction and mechanical features of the nozzle and stated that the testing apparatus could not build up sufficient pressure to rupture the structure. The Committee took no action although it authorized the issuance of a copy of Mr. Miller's report to the Dougherty Company, and in February they authorized the issuance of the report to Max Toltz of Milwaukee.

At the meeting of Sept. 15, 1924, two reports were received; one by S. F. Jeter on a sinuous forged wrought-steel header of The Walsh Weidner Boiler Company of New York showing that a working pressure of 480 psi could be carried, and the other by S. F. Jeter and Arthur M. Greene, Jr., on the test of dished heads for a drum, both with and without manholes, made by the Edge Moor Iron Company. If the thicknesses of the dished heads were computed in accordance with Par. 195, including allowances for manholes, and built of materials and other structural parts for which strength could be computed, no additional thickness need be added to compensate for tube holes located in the heads substantially as in the drums tested.

Some of these reports were extensive and contained such data as dimensions at different pressures and after relief and

descriptions of test apparatus and its performance. Curves were given from which the pressure at the elastic limit and hence the allowable working pressure could be determined.

CODE FOR BOILERS OF LOCOMOTIVES

On March 22, 1921, the ASME Council accepted the Rules for the Construction of Boilers of Locomotives, not subject to Federal inspection, Part I, Section III, of the ASME Boiler Code as presented by James Partington, member of the Subcommittee which prepared these Rules. The original subcommittee had been formed on Sept. 22, 1915, in considering Case 20 which was a request by the Davenport Locomotive Works for rules for locomotive boilers not under Federal control. It consisted of F. H. Clark, *chairman*, W. F. Kiesel, Jr., H. H. Vaughan, A. L. Humphrey, members representing the ASME Railroad Subcommittee, and S. F. Jeter, with John Wynne, a nonmember of the Boiler Code Committee.

The work was interrupted by the war and by disagreements among members of the Subcommittee over the different specifications for materials and for tubes and tube gages in use by different railroads as well as the question regarding factor of safety. However in April, 1919, a preliminary report was submitted to the Boiler Code Committee and printed for discussion at a public hearing at the 1919 ASME Spring Meeting in Detroit. After the report was approved by the meeting it was sent to all builders of locomotive boilers and was checked with A. G. Pack of the Interstate Commerce Commission and members of his staff. Constructive assistance was rendered by the Mechanical Division of the American Railway Association through the suggestions of A. W. Gibbs of the Pennsylvania Railroad, W. I. Cautley of the Lehigh Valley Railroad, and Joseph Chidley of the New York Central Railroad. Public hearings were held at St. Louis in the spring of 1920 and at New York on Dec. 7, 1920. When the report was made Messrs. Humphrey, Jeter, and Wynne had resigned from the Committee and were replaced by F. J. Cole, H. V. Wille, Kenneth Rushton, and James Partington. As the chairman, F. H. Clark,[1] was in China as Technical Advisor to the Ministry of Communication at Pekin, H. H. Vaughan,[1] as acting chairman, signed the report with Messrs. Cole, Kiesel,[1] Partington,[1] Rushton, and Wille.

Section III of the Code first called for the use of the material specifications given in Pars. 23 to 178 of Part I; and in Pars. L-2 through L-10 it specified the material from this group to be used for different parts of the boiler. Then followed paragraphs on the use of the tensile strength stamped on the plates, the crushing and shearing strength of rivets, and the minimum thickness of plates and tubes. The construction and maximum allowable working pressure for such locomotive boilers with the requirements for riveted joints, braced and stayed surfaces, and stays, were covered by Pars. L-20 to L-52, with reference to Pars. 410 to 416 of the Appendix of the Code for methods of computation. Of special value was Par. L-43 on staying for the wrapper sheet of locomotive boilers. This was a definite mathematical method of determining the maximum allowable pressure for the stayed wrapper sheet of a locomotive boiler figured for any point in its periphery. It was developed by the American Locomotive Company and was approved for use in the Power Section of the Code. Riveting was covered by six paragraphs and safety valves by thirteen. Steam gages, water glasses, fittings, and appliances were treated in Pars. L-72 to L-78. The description of the hydrostatic tests, stamping, and required data sheets completed this Code of 84 paragraphs covering 21 pages.

The principal subjects of dispute by the Boiler Code Committee and those attending the various hearings were the minimum gages of fire tubes, differing material specifications used by builders, and the factor of safety. The factor of safety was set at 4.5 for design and construction of new boilers and at not less than 4 for conditions in actual service.

On account of the limited use of this section of the Code, it was published as a separate document. In 1924 most of the sections of the Code were printed as separate books which permitted revision of sections for which changes were imperative without a reprinting of sections not revised.

At many of the meetings of the Boiler Code Committee objections were frequently made by H. V. Wille against the allowance of 95,000 psi for the crushing strength of rivets. He presented many data to sustain his opinion that a higher value be used. After years of consideration the Committee refused to change the original value.

MINIATURE BOILER CODE

Case 221, considered at the meeting of April 1, 1919, related to an inquiry from the Erie City Iron Works through Charles H. Garlick, member of the conference Committee from Allegheny County, Pa. The inquiry asked: "Is it necessary under the requirement of the Boiler Code that small vertical boilers such as used for clothes pressing, vulcanizing, and laundry service shall be fitted with gage cock when a water gage glass is attached?" The Committee replied that when such a boiler is operated with a fixed water level it should be fitted with gage glasses and gage cock or two gage glasses as indicated in Par. 294 Discussion of this case brought out the fact that C. O. Myers, chief inspector of boilers of the State of Ohio, had established a section of the new code for Ohio which referred to miniature boilers as distinguished from large boilers. He had also suggested a separate organization similar to the Conference Committee of the ASME Boiler Code Committee to pass upon and approve particular boilers. The need of such a subcommittee to formulate a Code for Miniature Boilers was evident to the ASME Boiler Code Committee and at the meeting of May 23, 1919, the Executive Committee, the Conference Committee, and F. C. Fairbanks were named as the Subcommittee on Miniature Boilers. At the meeting of Jan. 17, 1920, a smaller subcommittee was inaugurated with John A. Stevens as chairman and a membership consisting of C. E. Gorton, S. F. Jeter, and F. R. Low from the Boiler Code Committee; M. A. Edgar, T. C. Eipper, R. L. Hemingway, J M. Lukens, J. C. McCabe, C. O. Myers, J. Neil, J. F. Scott, and J. E. Speed from the Conference Committee; and also F. C. Fairbanks, V. E. Patnaude, and N. B. Ryan. Later Gerald Gearon was appointed to suceed Mr. Patnaude, and John H. Plunket was added to the Subcommittee. The chairman of the Subcommittee reported the draft of a proposed Code on Miniature Boilers to the Boiler Code Committee on June 23, 1921, and as immediate action was required it was directed that copies be sent to the members of the Subcommittee for study and report. The draft was partially approved at the meeting of Sept. 12, 1921, and at the October meeting it was ordered printed for the public hearing at the ASME Annual Meeting in December, 1921. The Boiler Code Committee considered the final draft of the Code on Miniature Boilers at its January, 1922, meeting and the ASME Council approved Code on March 6, 1922. This Code consisted of 19 paragraphs, M-1 to M-19, with an Appendix covering the Gas Burner Specifications of the American Gas Association. This publication covered eight pages.

The Code on Miniature Boilers first defined miniature boilers as shells, 16 in. × 42 in., with 20 sq ft of heating surface and 100 psi maximum working pressure. Materials and designs to be used were given with reference to specifications of Section II of the ASME Boiler Code. The requirements for washout plugs, pumps, feedwater connections, and water glass gages,

[1] Member of ASME Boiler Code Committee.

steam gages, safety valves, and stop valves were given in various paragraphs. The factor of safety to be used was the same as that for power boilers and provisions were made for the standard marking of each boiler as well as the manufacturers' report giving the hydrostatic pressure applied to the boiler.

A new 1924 Edition of this Section V as a separate book was similar to that of 1922 except that certain references were altered to conform with numbering of the Boiler Code of 1924 and individual shop inspection was called for in the same manner as for power boilers.

AUTOGENOUS WELDING

The Subcommittee on Welding of which F. L. Fairbanks was chairman, referred to in the previous chapter, had been originally appointed by direction of the ASME Council on March 15, 1918, in response to a request for co-operation from the Electric Welding Society.

On June 4, 1918, the ASME Council referred to the Boiler Code Committee a communication from the National Welding Council asking for the co-operation of the Society at a conference. F. L. Fairbanks reported this Welding Committee conference to the Council on Jan. 17, 1919. The conference was held on Jan. 3, 1919, through the invitations of C. B. LePage, Secretary of Standards and Technical Committees of ASME and was called by Prof. Comfort A. Adams, chairman of the Welding Committee of the Emergency Fleet Corporation. These were representations of the ASCE, AIEE, ASME, ASTM, Naval Architects, Automotive Engineers, Master Mechanics, Car Builders, Emergency Fleet Corporation, U. S. Navy, Engineering Council, Engineering Foundation, National Welding Council, and a number of shipbuilders.

Dr. Adams stated that as the Emergency Fleet Corporation would probably be discontinued within about a month he felt that its research should not only be made available but that some means should be provided for a continuance of this research which at that time seemed to be absolutely necessary for the success of the science as well as the art of welding.

The meeting concluded by accomplishing a tentative organization to be known as the American Welding Association. It was suggested that the present Welding Committee of the Emergency Fleet Corporation solicit from the proposed shipbuilding contracts sufficient funds to keep the research work active until such an organization could be perfected and so finish the work which had been planned.

Among the suggestions made was one that some way be found to make the new organization a scientific body so as to gain the confidence of engineers in general and also eliminate the taint of commercialism, still retaining, if possible, the financial support of individuals and corporations interested in the advancement of welding.

It seemed to be the consensus of opinion that all national or rather prominent engineering societies should be represented in the new association and that a way might possibly be found to merge the welding research of the Bureau of Standards, Bureau of Mines, War Department, and Navy Department and thereby eliminate a great amount of duplication of effort which had been the rule rather than the exception in the past.

Mr. Fairbanks felt that welding, in its various branches at that time, was one of the most important subjects in the field of engineering. Because of the lack of knowledge and of the means to obtain constant qualitative results, assistance should be given in every reasonable manner possible. Care should be exercised in the direction of this work as much money had already been expended without adequate results owing to the fact that various committees and organizations had been merely duplicating the work of each other with very little advancement.

He further suggested that if aid were given by ASME no action should be taken which might be interpreted as compromising the judicial standing of the ASME Boiler Code Committee when considering welding problems which might be brought before it.

This report was received by the ASME Council, which approved the recommendation that the Society be represented in the new association to continue the work in welding research but not to involve the Society in any financial obligation without further authorization by the council.

During 1919, a number of cases involving welding were referred by the Boiler Code Committee to the Subcommittee on Welding.

In January, 1920, C. W. Obert reported a recent Conference of the National Welding Council with the representatives of the welding industry at which complaints were made of the inactivity of the Boiler Code Committee on the subject of welding. It had been suggested that some form of licensure of welders or other arrangements should be made to legalize the art of autogenous welding in the ASME Boiler Code.

As the National Welding Council was to be discontinued, a new organization was to be formed to be known as the American Welding Society with which the American Bureau of Welding was to be affiliated. This was to be a body representing the entire industry and would eliminate commercial aspects, undertake research and standardization, and act as a judicial body providing a medium for advancing the science and art of welding. It was moved by the National Welding Council that the ASME Council be requested to invite the American Welding Society to appoint a committee to confer with the Boiler Code Committee on welding the joints of pressure vessels.

On June 24, 1920, the International Acetylene Association was informed by the Boiler Code Committee that the Committee was not in position to rule on the safe ending of tubes by the oxyacetylene method as there was nothing in the ASME Code to permit it. The Committee stated that it was not warranted in sanctioning the use of autogenous welding for that purpose until rules and restrictions could be prepared which would insure sound welds. If the Association was prepared to submit such rules, the Committee would be pleased to have the opportunity of inspecting them. The inquiry was referred to the Subcommittee on Welding which reported at the next meeting and the same reply was given to it as had been given to former Case 80.

An article appeared in MECHANICAL ENGINEERING for October, 1920, page 572, by O. H. Eschholz, "Metallic-Electrode Arc-Welding Process," and at the 1921 ASME Spring Meeting in Chicago, R. S. Johnson of the U. S. Bureau of Standards presented a paper, "An Investigation of Oxyacetylene Welding and Cutting Blowpipes."

At the Boiler Code Committee meeting on June 23, 1921, a letter from E. R. Fish, chairman of the Subcommittee on Air Tanks and Pressure Vessels, stated that specific provisions for welding were needed by his committee and for this reason the Unfired-Pressure-Vessel Code could not be issued. Mr. Fairbanks stated that his Subcommittee on Welding was almost ready to report, but that the report was being withheld out of courtesy to the American Welding Society and the American Society of Refrigerating Engineers. A conference of these three bodies was held later at which it was agreed that the American Welding Society and the ASRE would obtain data on autogenous welding and the Subcommittee on Welding would obtain data on forge welding.

At the October meeting Mr. Fairbanks, of the Welding Subcommittee, reported that the conference with a committee of the American Welding Society had failed to give the necessary assistance in formulating a Code on Autogenous Welding.

He then referred to a joint meeting of the Executive Committee of the Boiler Code Committee with the Subcommittee on Welding (held the previous week) at which he explained the failure and requested instructions concerning the procedure if the AWS Committee should fail to present the report which had been prepared. It was the opinion of the Boiler Code Committee that the Subcommittee on Welding should prepare a Code on Welding with a view to rendering an early report, provided the report were submitted to the co-operating bodies with ample notice of the reason for independent action.

In view of this decision, Mr. Fairbanks then discussed with the Executive Committee the various essentials of a welding Code and the class of vessels to which it would apply. He reported the findings of the AWS Committee that autogenous welding might be applied to pulp digesters, rendering tanks, oil stills, pressure tanks for distilling oils, autoclaves, brick drying and creosoting cylinders, steam receivers and separators. Longitudinal seams of pressure vessels for noxious or explosive gases or liquids and for longitudinal seams of vessels over $^{5}/_{8}$ in. thick should not be included. He requested instructions as to procedure when decisions were known to be unfavorable to the conferring bodies. After discussion it was recommended that the Subcommittee should stand on its position if it could be shown that the field had been sufficiently investigated and its position was sound. It was moved by Mr. Fish and seconded by Mr. Gorton that the Subcommittee on Welding present its Code along the lines outlined by its chairman, Mr. Fairbanks, and that thanks be extended to him and the Subcommittee for their arduous efforts in establishing the Code.

A conference of the Boiler Code Committee with manufacturers using forge welding was held on April 6, 1922. Manufacturers present were M. W. Kellogg, F. W. Speller, Charles L. Rowland, and J. Hall Taylor. The Committee discussed with them the preliminary draft for the Rules for the Production of Forge-Welded Pressure Vessels.

As a result of this conference the Boiler Code Committee considered necessary changes in many of the thirteen paragraphs dealing with forge welding which had been discussed at the public hearing on Dec. 5, 1921, and which S. W. Miller was requested to have introduced with the section of the proposed Code for Unfired Pressure Vessels dealing with forge welding.

At the meeting of Sept. 20, 1922, the Subcommittee on Air Tanks and Pressure Vessels reported the results of a public hearing on the proposed Code for Unfired Pressure Vessels at the 1922 ASME Spring Meeting held at Atlanta, Ga. This Code contained rules for the fusion process of welding prepared by the Subcommittee on Air Tanks and Pressure Vessels and the Subcommittee on Welding. In discussing this section Dr. Comfort A. Adams of the American Bureau of Welding, said that he believed that tests would show the suitability of welds for use in pressure vessels and that he also approved the hammer test of such welded vessels. Locked-up stresses could be revealed by stretching and also by a test to the yield point. He felt that the Boiler Code Committee had been fair and progressive in taking definite steps. Messrs. Couch and Small of the ASRE and S. W. Miller disputed the limitation against welding longitudinal joints.

At a public hearing on the Low-Pressure Heating Boiler Code at the 1922 ASME Annual Meeting in December, three of the thirteen paragraphs of the Section on Autogenously Welded Boilers were also discussed. As the Low-Pressure Heating Boiler Code was adopted in 1923, it was the first Section of the Boiler Code in which autogenous-welding rules appear.

At a joint meeting of the Subcommittee on Welding with a special committee of ASTM consisting of F. N. Speller, E. F. Kennedy, and J. O. Leach, it was concluded that the ASME Boiler Code Committee should provide general rules covering the selection of materials for different welding methods. Specifications were given for flange-quality and structural-quality steel for welding.

S. W. Miller of the Subcommittee on Welding reported (March 23, 1923) on the work of the Bureau of Standards in testing welded tanks. His information was taken from a report of the American Bureau of Welding. Tests were made on 48 tanks of different types and construction. The American Bureau of Welding had made specific recommendations on welding based wholly on tests.

On June 18, 1924, S. W. Miller complained in a written report that there had been no meeting of the Subcommittee on Welding since Sept. 19, 1922, and referred to the following researches and papers recently published on the subject of welding:

"Fusion Welding," by S. W. Miller, American Iron & Steel Institute, November, 1921.

"Strength of Electrically Welded Pressure Containers," by R. J. Roark, 1922 ASME Spring Meeting, Atlanta, Ga.

"Tests on Welded Cylinders," by E. A. Fessenden and L. J. Bradford, 1922 ASME Meeting, Atlanta, Ga.

"Some Principles of the Construction of Unfired Pressure Vessels," by S. W. Miller, 1922 ASME Spring Meeting, Atlanta, Ga.

Bulletin No. 5, American Welding Society, 1923, Work of Bureau of Standards on Welded Tanks.

This report appeared in full in the *Journal* of the American Welding Society, May, 1923.

Mr. Miller stated that the Roark tests with gas and electric welds on longitudinal seams ruptured in the welds and showed efficiencies of 61 per cent of plate or 51 per cent of weld. The Fessenden and Bradford test on 12-in. shells resulted in an efficiency in excess of 61 per cent when rupture was not in the weld and an efficiency of 79 per cent when the failure was in the weld.

The Miller paper on fusion welding dealt with strength and structure of welds, the effect of welding on the base metal, and impact bending tests showing the advantage in low-carbon steel. His paper on the construction of unfired vessels reported tests on longitudinally double-V-welded seams of 24-in. tanks of $^{1}/_{2}$-in. metal. There were leaks in small pinholes when tested to practically the ultimate stress in the shell and at 800 psi there were no failures on the hammer test.

Bulletin No. 5 reported tests on 48 tanks made in different shops with different kinds of seams and different ways of attaching heads. The tests were made at the Bureau of Standards, and the Bulletin contained complete details of analysis of materials and physical tests. The report of the Pressure Vessel Committee of the American Bureau of Welding discussed the results of these tests and drew conclusions from them. The lowest strength of any double-V longitudinal seam was 90 per cent of the plate strength. The average was in excess of 100 per cent. The single V could not be relied upon.

Mr. Miller, in a masterful manner, defended fusion welding on the basis of his own experience and the testing of his own product as well as tests on structures built by others. His letter to the Boiler Code Committee made clear the success of autogenous welding and the requirements for welds which were reliable.

LOW-PRESSURE HEATING BOILER CODE

At the first meeting of the Committee in 1919 the secretary, C. W. Obert, called attention to the need to consider the Heating Section of the new 1918 Code. This section had been formulated on the basis of Committee actions only as the National Boiler and Radiator Manufacturers Association had neglected the needs and frequent requests of the Boiler Code Committee, although frequently officers of the Association had asked

the ASME Council to appoint from one to three members of their organizations to the Boiler Code Committee. These appointments were not made because the ASME Council had never appointed members on the basis of their membership in trade organizations. Mr. Obert suggested that a Conferring Committee of the American Society of Heating and Ventilating Engineers be appointed to co-operate with the Subcommittee on Heating Boilers. On May 23, 1919, a Subcommittee on Heating Boilers was proposed with a Conferring committee of the ASHVE consisting of consulting engineers, university professors, designing engineers, contractors' engineers, and manufacturers. The Subcommittee appointed on Sept. 26, 1919, consisted of S. F. Jeter, *chairman*, Wm. H. Boehm, Charles E. Gorton, M. F. Moore, and R. D. Reed, with a Conferring committee from the ASHVE of L. A. Harding, W. S. Timmis (Consulting Engineers), J. R. Allen, L. P. Breckridge (university professors), P. J. Dougherty, J. F. McIntire (designers), H. M. Hart, W. H. Driscoll (contractors), Homer Adams and A. A. Landon (manufacturers). On April 6, 1922, R. W. Butterfield and O. T. Nelson were added to the committee and Wm. B. Reed succeeded R. D. Reed.

At the discussion of revisions to the Code on Sept. 1, 1921, the Boiler Code Committee was informed by R. D. Reed that the Subcommittee on Heating Boilers had not met since May, 1920. He outlined the necessity for early work and the secretary of the Boiler Code Committee was directed to bring to the attention of the chairman of the Subcommittee the importance of the work of his committee. On Oct. 27, Charles E. Gorton reported that great progress had been made by the Subcommittee at its meetings on Oct. 27-28, and that entire harmony existed between the different groups which were formulating the specifications for good cast iron for all boilers made of that metal. The Boiler Code Committee directed the Subcommittee to formulate rules for welding heating boilers.

The Subcommittee reported on July 20, 1922, that it had held five meetings in February, three in April, and two in July. It submitted two sections of the Code; one on plate boilers and one on cast-iron boilers, comprising Pars. H-1 to H-120. Slight changes were suggested for many of these paragraphs while others required revision.

A public hearing was held on the Heating Boiler Code on Dec. 8, 1922, with the chairman of the Subcommittee, S. F. Jeter, presiding. Fifty persons attended the meeting. F. W. Herendeen, secretary of the National Boiler and Radiator Manufacturers Association, reported a resolution of the Association on the splendid work on revision by the Subcommittee and favored all but a few paragraphs in Appendix II. J. C. McCabe stated that there was a hazard in welding when hot metal was not obtained. Reheating was discussed, and H-30 was amended to read that red was to show for a width of at least 3 in. in daylight. Stop pins were suggested on steam and altitude gages.

The Boiler Code Committee voted that no paragraph on the rating of heating boilers should be included in the Code and that gas-fired boilers for domestic hot water should be excluded from the Code. The Boiler Code Committee then proceeded with the approval of revisions and directed that the revisions be sent to the Massachusetts Board of Boiler Rules with minutes of the public hearing.

The Code for Low-Pressure Heating Boilers was submitted to the ASME Council on March 23, 1923, and was approved on May 23, 1923. It was signed by S. F. Jeter,[2] *chairman*, R. W. Birchfield, Wm. H. Boehm,[2] Chas. E. Gorton,[2] M. F. Moore, O. T. Nelson, and Wm. B. Reed.[2]

STEEL PLATE BOILERS

This Code was published as a separate book as Section IV of the ASME Boiler Code. It was made up of Part I, Steel Plate Boilers (Pars. H-1 to H-83), and Part II, Cast-Iron Boilers (Pars. H-84 to H-120), and contained 113 pages.

The limitation of the Code to steam boilers with pressures of 15 psi and hot-water boilers to 160 psi and 250 F was stated in Par. H-1. In Par. H-4 the method of computing the maximum allowable working pressure was given. The material to be used in various parts of the boiler and the ultimate strength and minimum thickness of plates and tubes followed the rules for power boilers. Joints, braces, and stayed surfaces were treated in Pars. H-15 to H-26, and boiler openings, supports, settings and installations, and fittings and appliances, including safety valves, were covered in 38 paragraphs. The hydrostatic test with shop inspection, stamping, and marking was treated in Pars. H-65 to H-68.

The concluding fifteen paragraphs of Part I were devoted to autogenously welded boilers. This portion of the Code defined terms and described the boilers on which autogenous welding might be used. It specified the methods to be used in design, the requirements for the base metal and filling metal to be used, and methods of welding and inspection.

CAST-IRON BOILERS

Pars. H-84 to H-86 of Part II (Cast-Iron Boilers) limited the pressures and temperatures to be used with cast-iron boilers, and Pars. H-87 to H-89 contained requirements for boiler openings, flanged connections, and threaded openings. Six paragraphs were devoted to the installation of the boiler and twelve to safety valves and relief valves. Steam and altitude gages, water gages, gage cocks, thermometers, regulators, blowoffs, water-column pipes, and fusible plugs were covered, and requirements for hydrostatic test, inspection, stamping, and marking were stated.

Discussion developed on the basis for determining the relieving capacity of safety valves. Grate area, heating surface, radiating service, and horsepower had been used. Ratings of boilers differed so much in the trade that it was decided to base the size of the safety valve or relieving capacity on the grate area.

Section IV of the Code became the first receiving Council approval to provide for autogenous welding of sheets and other parts of boilers.

SECTION VIII—UNFIRED PRESSURE VESSEL CODE

The questions of the needed Safety Code for Pressure Vessels other than Steam, of Rules for the Operation of Boilers, and of Recommendations apart from Rules were again considered by the Boiler Code Committee at its meeting of Dec. 22, 1916, but because revision of the 1918 Code was under way, these matters could not be given due consideration at that time. It is well to remember, however, that the original Boiler Code Committee was appointed to formulate standard specifications for the construction of steam boilers and other pressure vessels and for their care in service.

The minutes of the ASME Council for Feb. 16, 1917, record a communication from the Compressed Air Society which requested consideration of rules to cover pressure vessels other than steam which had been omitted in the first Code of 1914. That society was asked to submit to the Boiler Code Committee a brief covering the changes in or additions to the Code, with supporting arguments, as a basis for rules which it would regard as being equitable with scientific facts.

C. W. Obert reported on April 1, 1919, that on an extensive trip he had found that a great need existed for a Code for Air Tanks and Pressure Vessels. Some manufacturers, he stated, were using the Power Boiler Code as a basis of design of these other types of vessels. The Boiler Code Committee appointed

[2] Member of ASME Boiler Code Committee.

a subcommittee on the subject which consisted of E. R. Fish, *chairman*, Wm. H. Boehm, C. E. Bronson, E. C. Fisher, S. F. Jeter, W. F. Kiesel, Jr., and James Neil. In less than a month after its appointment this committee was asked to report soon. On Oct. 24, 1919, Mr. Boehm reported that the Subcommittee had prepared a preliminary report and had sent it to all members with a discussion of formulas for stress based on elastic limit and maximum elongations for use for substances other than steel as prepared by W. F. Kiesel, Jr. This was sent to the Council for permission to publish.

The formulas for stress were given as

For Class A, $S = 0.0125\ E\ [\epsilon + 8]$ not more than $0.4\ E$

For Class B, $S = 0.0125\ E\ [\epsilon + 16]$ not more than $0.65\ E$

in which E = elastic limit, psi, and ϵ = elongation, per cent in 8 in.

The subject headings of the proposed Code were: Definitions, Materials, Stresses, Safety Appliances, Supports, Corrosion Allowances, and Stamps. This Code was revised for a public hearing held in St. Louis, May 24–27, 1920.

The American Engineering Standards Committee was reported to have asked the ASRE to sponsor a Refrigerating Code on Air Tanks and Pressure Vessels prior to the Boiler Code Committee meeting of June 24, 1920. On Sept. 24, 1920, the Boiler Code Committee proposed to ask the ASRE to appoint a committee for conference purposes to be composed of representative consulting engineers, college professors, designers, manufacturers, and contractors. Fred Ophuls, *chairman*, Louis Doelling, E. F. Miller, N. Small, and H. Sloan were appointed to represent that society.

A public hearing on what was now called the Code for Unfired Pressure Vessels (Third Draft) was held on Dec. 5, 1921. This Code was a 24-page pamphlet entitled "Preliminary Report." There were 200 persons at the morning and afternoon sessions and the preliminary report was discussed by paragraphs. All discussions were recorded. Mr. Fish gave credit to Dr. Jacobus for his two weeks' work in preparing the printed report and for his suggestions and enthusiasm.

As the need for this Code was urgent, the Boiler Code Committee, on Jan. 19, 1922, voted that "all matters pertaining to the Proposed Unfired Vessel Code be turned over to the Subcommittee on Welding which shall be requested to revise it so as to present a Welding Code to the Boiler Code Committee and to confer as it sees fit with the Executive Committee."

At the January meeting, the Range Boiler Manufacturers, who at two lengthy meetings had shown that it was practicable to build safe boilers for domestic hot water by brazing, presented their proposed rules for the construction of range boilers and other vessels for the storage of hot water, which would meet their requirements, and asked for the exclusion of their product from the Code for Unfired Pressure Vessels. These matters were clearly stated, and the manufacturers were complimented and thanked for their report. As a result of these meetings, tanks for domestic hot water and water storage were excluded from the Code on Hot Water Heating Boilers and the Code for Unfired Pressure Vessels.

A session on welding in connection with the Code for Unfired Pressure Vessels at the 1922 ASME Spring Meeting at Atlanta was reported to the Boiler Code Committee on June 29, 1922. Different classes of vessels were discussed as well as the Kiesel formula for maximum allowable working tension based on elastic limit. On Sept. 20, 1922, Mr. Fish reported that the Subcommittee, on Sept. 19, had discussed the report of the Atlanta session, had revised various paragraphs of the Code, and had added a new section on autogenous welding as shown in a submitted statement.

A public hearing on the Unfired Pressure Vessel Code (Fourth Printing), was held on Dec. 4, 1922, with Mr. Fish presiding.

At the meeting of Dec. 10, 1923, Mr. Fish, chairman of the Subcommittee on Unfired Pressure Vessels, called on E. M. Verner of the Scaife Co., Charles Gordon, of the Electric Railway Association, and W. S. Coakley of the Pressed Steel Tank Co. to present their views on a minimum thickness of $^1/_8$ in. for plates for air tanks. At this meeting they were asked to submit written statements at a later date.

Again, at the Boiler Code Committee meeting of Feb. 7, 1924, the great need for the Code for Unfired Pressure Vessels was stressed and Mr. Fairbanks joined in the discussion. Mr. Fish was requested to rewrite the preliminary draft and submit it to his subcommittee for final approval. It was then to be set in type and published in MECHANICAL ENGINEERING.

A conference of the Subcommittees on Unfired Pressure Vessels and on Welding and representatives of the American Society of Refrigerating Engineers, the American Welding Society, The American Electric Railway Association, and certain individuals was held on June 17, 1924, under the chairmanship of E. R. Fish, for the purpose of discussing revisions of Pars. U-12, U-47, U-48, U-101, U-132, and U-135 of the Code for Unfired Pressure Vessels.

S. W. Miller submitted a report of 19 pages which contained facts and able criticism. This report has been mentioned earlier under autogenous welding but his criticism of the Unfired Pressure Vessel Code is given at this point. In this masterful criticism he pointed out that the classifications were faulty and that the Code had one paragraph, U-2, on safety appliances, while the Power Boiler Section had a much greater number. He then discussed many of the paragraphs specifically calling attention to errors.

The Subcommittee assured the conference that the opinions of the participants would be considered by the Boiler Code Committee during the summer.

At the meeting of the Boiler Code Committee on Sept. 15, 1924, Mr. Fish submitted the changes with the resolutions of the conference favoring all of them. The Committee directed that a redraft of the Code be submitted to the Subcommittees on Unfired Pressure Vessels and on Welding and then to the Executive Committee for publication. This sixth draft of the Code was published in MECHANICAL ENGINEERING for December, 1924, and the Code for Unfired Pressure Vessels was adopted by ASME Council on Jan. 15, 1925, as Section VIII of the ASME Boiler Code.

RULES FOR INSPECTION—SECTION VI OF CODE

As a result of the desire of the National Boiler and Radiator Manufacturers Association for a Model Inspection Law, the Boiler Code Committee decided to form a subcommittee to prepare Rules for Inspection of Material and Steam Boilers which would be suggestive only and not a mandatory part of the Code. On May 16, 1918, the Boiler Code Committee suggested the names of Charles S. Blake (Hartford Steam Boiler Inspection and Insurance Co.), as chairman, and Charles E. Gorton (Gorton and Ledgerwood), F. W. Herendeen (National Boiler and Radiator Manufacturers Association), James Partington (American Locomotive Co.), and John S. Thompson (Travelers Insurance Co.), as members of such a subcommittee.

The Boiler Code Committee received a copy of a communication from Mr. Blake to C. W. Rice, secretary of ASME, asking for instructions as to the purpose of the Subcommittee and it was voted that the Subcommittee should be limited to the preparation of rules for inspection which could form the basis of a bill to include the inspection of materials, construction, and auxiliaries of boilers in use.

On Sept. 26, 1919, the Boiler Code Committee voted that the subcommittee prepare a model inspection bill and rules

of inspection for the guidance of state boards of boiler rules of states or municipalities adopting the Code.

Mr. Blake reported on the work of the Subcommittee on Dec. 1, 1920, and asked if its work should include tolerances and fittings for boilers. It was felt that this information would greatly aid the subcommittee. Some members of the Boiler Code Committee thought that although there should be a uniform law for inspection, such a law should be formulated by the inspectors. It was voted that the National Board of Steam Boiler and Pressure Vessel Inspectors be requested to appoint a member to this Subcommittee and that the American Boiler Manufacturers Association appoint two representatives to the Subcommittee.

At this Committee meeting W. P. Eales was appointed a member of the Subcommittee to replace J. L. Thompson who had resigned.

The chairman of the Subcommittee reported on Dec. 6, 1921, that it had unanimously agreed to the proposed Rules for Inspection with only two absentees, and that when these rules had been rearranged and harmonized they would be resubmitted to the Subcommittee and presented to the Boiler Code Committee. He cited the valuable assistance of the three members of the National Board of Steam Boiler and Pressure Vessel Inspectors. The Boiler Code Committee (April 6, 1922) directed the chairman of the Subcommittee to present the tentative rules to the American Boiler Manufacturers Association.

These rules were presented at the ASME Spring Meeting at Montreal on May 30, 1923. Certain suggestions were made for further consideration by the Subcommittee. The final report of the Subcommittee was approved by the Boiler Code Committee on Dec. 10, 1923, with thanks to the Subcommittee which it desired to retain as an advisory committee. The rules were included by ASME Council in its approval of the Boiler Code of 1924 as Section VI and were first published as a separate document.

Section VI was made up of two parts, one for new boilers, Pars. I-1 to I-37 and the other for installed boilers, Pars. I-38 to I-61. Rules covering the general inspection of material were followed by those relating to plate material and its properties, stamps, measurements, boiler manufacture, allowances, curvature, beveling, calking, and fittings. The puncturing, reaming, drilling, and subsequent treatment of rivet holes, the heads of rivets and their eccentricity, were discussed in detail. Rules covering the inspection of tubes and tube-hole tolerance were followed by those on flaring and heading of tube ends. Flanging, staying braces and stay fittings, as well as crown bar and dished-head inspections, were described. Handholes, manholes, washout openings, attachments, fittings, and plugs completed the elements to be inspected, and the section closed with rules on hydrostatic test, application of the stamp, inspection of place of installation, and record of the complete boiler.

The second part of Section VI began with general instructions, details on scale, oil, corrosion, grooving, stay openings, fire surfaces, joints, cracks, tubes, ligaments, steam pockets, pipe connections, and water columns. Inspection of baffling, heat localization, freedom of expansion, safety valves, and steam gages were then described, and paragraphs on examination for imperfect repairs and hydrostatic test methods finally closed the rules except for the general suggestions of Par. I-60. On Feb. 7, 1924, the Boiler Code Committee approved these Rules as Section VI of the ASME Boiler Code, to be published with the Power Boiler, Section I, of the Code.

RULES FOR CARE OF POWER BOILERS—SECTION VII

At the meeting of Dec. 6, 1921, a communication from F. M. Gibson, plant engineer of the American Sugar Refining Company, South Boston, Mass., was read. This communication referred to Rules for the Care of Power Boilers which had been originally planned by the Boiler Code Committee and had been brought before the Committee at its meeting, Dec. 22, 1916. John A. Stevens, chairman of the Boiler Code Committee, requested reconsideration of the subject by the appointment of the following subcommittee:

F. M. Gibson, plant engineer, American Sugar Refining Co.
H. F. Scott, master mechanic, Dennison Manufacturing Co.
J. R. Gill, plant manager, Bronze Metal Co.
M. H. Larking, Jr., power and safety engineer, U. S. Rubber Co.
Nicholas Stahl, generation engineer, Narragansett Electric Light Co.
J. Wolf, mechanical engineer, Cleveland Electric Illuminating Co.
W. G. Dinan, superintendent of power, Amoskeag Manufacturing Co.
J. S. Schumaker, manager, United Paperboard Co.
E. G. Bailey, president, Bailey Meter Co.
J. W. Hayes, consulting engineer, J. W. Hayes Co.
S. F. Jeter, chief engineer, Hartford Steam Boiler Inspection and Insurance Co.

The Subcommittee was appointed by the ASME Council on Jan. 7, 1922, and its chairman, Mr. Gibson, reported on March 2, 1922, that the most important questions before the Subcommittee were those of operating pressures and the weakening of boiler structures during use. The Subcommittee met monthly, and by April 26, 1923, a report for discussion at a public hearing at Montreal was presented to the Boiler Code Committee. The report included 312 numbered paragraphs. On May 29, 1923, the ASME Council approved this preliminary report for use at the hearing. C. F. Hirshfeld severely criticized the proposed Code, reported that the Prime Movers Committee and the Steam Turbine Committee of the Association of Edison Illuminating Companies felt that the Code was neither safe nor satisfactory, and urged restricting action at that time. After consideration of the suggestions the Subcommittee continued its work through 1924.

CONFERENCES AND HEARINGS

The Boiler Code Committee held a number of conferences during the years 1919–1924 with individuals and groups of certain manufacturers in an effort to formulate a safe Code which would sanction improvements brought about by advances in the manufacture of materials and new devices. Six of these are described below.

ASTM SPECIFICATIONS

The American Society for Testing Materials had published safe material specifications based on careful consideration by manufacturers, engineers, and users of materials which had had the respect of the engineering world. The specifications of the 1914 ASME Boiler Code had been based on those of ASTM. Differences, although slight, meant specifications different from those used by the engineering profession and manufacturers. Hence it became evident in the administration of the first Code that there must be co-operation between the Boiler Code Committee and the American Society for Testing Materials and certain manufacturing groups as noted in the previous chapter. A Subcommittee to confer with ASTM, appointed in Dec. 9, 1916, consisted of D. S. Jacobus, S. F. Jeter, and Wm. F. Kiesel, Jr., while F. W. Rys, F. J. Cole, and C. D. Young represented ASTM. Because of this co-operation the specifications of the 1918 Edition of the ASME Boiler Code were more nearly in agreement with ASTM specifications. Still closer co-operation

was needed. The Conferring Committees of the two societies met frequently and several hearings were held with manufacturers' representatives so that in the 1924 Edition of the Code ten specifications were in complete agreement with ASTM specifications, four in substantial agreement, and two covered materials for which the American Society for Testing Materials had no corresponding specifications.

The composition of the Conferring Committees had changed during the years. S. F. Jeter resigned and was replaced by James Partington, and when Dr. D. S. Jacobus retired he was replaced by Isaac Harter, Jr., who later resigned and was replaced by Perry Cassidy as chairman. For the ASTM, J. A. Clapp replaced C. D. Young and later he was replaced by C. L. Warwick, and on the resignation of F. J. Cole, E. J. Edwards was appointed to succeed him. To these Conferring Committees the American Association of Steel Manufacturers added another consisting of J. O. Leech, chairman, E. F. Kennedy, and A. D. Peace.

These committees endeavored to select and secure agreement on ASTM specifications which would give industry the necessary definite information for the production of proper materials. The committees considered and reported on 13 different specifications for the Code on April 26, 1923, and recommended some adoptions and some alterations.

One of the questions brought by them to the Boiler Code Committee was that on stamping steel sheets where cutting was necessary in fabrication on which J. O. Leech presented arguments for simplification.

At a hearing of five representatives of the American Association of Steel Manufacturers on Sept. 28, 1923, the qualities of flange and firebox steels were discussed and specifications for stay-bolt steel and steel bars were presented.

SEAMLESS AND WELDED TUBES

On the same date 11 representatives of Boiler Tube Manufacturers discussed the Code differences between seamless and welded tubes. They suggested that the single Table 2 be replaced by two tables, one for steel and one for wrought iron. Then attention was directed to the report of the Subcommittee on Piping and the formulas used therein.

SAFETY VALVES

Revision of the paragraphs relating to safety valves, which had been adopted for the 1918 edition of the Code without the full co-operation of the manufacturers, was the subject of another hearing. The Boiler Code Committee heard from representatives of 11 different manufacturers of safety valves at the meeting of May 23, 1920. Exceptions were taken to 17 paragraphs dealing with these attachments. These paragraphs were discussed, and on June 27 the exceptions were reported in writing. The Boiler Code Committee decided that most of the exceptions could be handled by interpretations and that a few required conference. The advisability of a subcommittee on conference was considered on Feb. 3, 1921, and on Dec. 6, 1921, A. B. Carhart of the Crosby Steam Gage and Valve Co. appeared before the Boiler Code Committee as the representative of the manufacturers to learn if the Committee was prepared to consider the revision of the safety-valve section of the Code and if it would accept recommendations. He referred to the Conference of 1919 and other matters and asked for a meeting of the manufacturers with the Boiler Code Committee. The chairman of the Boiler Code Committee asked the manufacturers to prepare data for presentation. This presentation was made on June 29, 1921, and referred to 15 paragraphs and two tables. Another hearing was held on Sept. 28, 1923, with ten men representing five companies participating. There was some disagreement among members of this group and the Boiler Code Committee suggested that they meet together for agreement before asking the Committee to act. A report of complete agreement was made on Oct. 30, 1923, and the revised paragraphs were ordered printed in the next issue of MECHANICAL ENGINEERING.

MALLEABLE IRON

A hearing was again given to John C. Parker on April 6, 1922, this time to consider the question of raising the allowable working pressure on malleable-iron boxes from 200 psi to at least 300 psi. Mr. Parker cited the use of his boiler in England under a pressure of 300 psi and stated that his units were tested to 500 psi. The Boiler Code Committee appointed the former Subcommittee on Malleable Iron, which consisted of Arthur M. Greene, Jr., S. F. Jeter, Wm. F. Kiesel, Jr., and E. F. Miller, to consider this request and to report on it. The Committee again turned to Prof. Enrique Touceda, director of the Malleable Iron Research Institute, for information regarding improvements in malleable-iron castings. By comparative tests on samples of malleable-iron bars, cast-steel bars, and shell-plate bars under continued exposure to the gases above the fire box, in the superheater, and in the last pass of a B & W boiler, changes in physical properties as well as improvements in manufacture suggested that a pressure higher than 250 psi was permissible. The Boiler Code Committee had difficulty in reaching a conclusion, but it finally placed the allowable working pressure for malleable iron between that for steel and cast iron, i.e., 350 psi, with test pressure of 2250 psi. It further stipulated that the malleable iron should conform to the specifications for malleable castings.

BRAZED TANK SEAMS

A hearing was given R. E. Cecil, E. L. Verner, and A. L. Wurtz of the Range Boiler Manufacturers Association on June 23, 1921, to obtain information on their methods of making brazed tank seams and how these differed from autogenous welding. For 25 years there had been no failures of seams made according to their materials specifications and by their brazing process. As the general specifications for the process were incomplete and tentative in form only, the group did not wish to present them at that time. They planned to revise the tentative forms and then present a comprehensive set of rules to the Subcommittee on Air Tanks and Pressure Vessels.

At a hearing on Jan. 19, 1922, E. M. Venner, chairman, Victor Manck, and L. Hassinger of the Range Boiler Manufacturers Association presented copies of a letter to E. R. Fish, chairman of the Subcommittee on Air Tanks and Pressure Vessels, requesting the exclusion of range boilers and water storage tanks from the ASME Code. Copies of their Rules for the Construction of Range Boilers and Other Vessels for the Storage of Hot Water were presented at the same time. The members of the delegation were questioned extensively as to construction, factor of safety, and other data. They were congratulated on their clear and concise statements and a resolution of thanks was passed. John A. Stevens stated that he had heard from ten members of the ASME Conference Committee (state inspectors) approving the exclusion of such tanks.

From the facts gained at these hearings these structures were excluded from the Heating Boiler Code and from Unfired Pressure Vessels Code.

Other personal appearances occurred throughout this period to clarify inquiries or to express needs for relief.

At the meeting of March 22-23, 1923, the results of a joint meeting of representatives of the Massachusetts Board of Boiler Rules, Messrs. Plunkett and Collins, and of the Boiler Code Committee, Messrs. Jacobus, Kiesel, and Vaughan, were presented under 25 headings with the recommendations of the

joint committee. The recommendations were for the purpose of bringing the two Codes into agreement. The Boiler Code Committee then discussed the recommendations and tabulated what further considerations should be investigated.

REVISION OF POWER BOILER CODE

The revision work for the 1924 Edition of the ASME Boiler Code began on Feb. 3, 1922, and continued until Feb. 8, 1924, with a public hearing on Dec. 5, 1922, at which an attendance of 75 was recorded.

In this revision the work of the Conferring Committee with ASTM, the hearings of the Safety Valve Manufacturers, the American Association of Steel Manufacturers, and the Range Boiler Manufacturers Association, and the report of the Subcommittee on the use of malleable iron were of value.

Discussion of the report of a conference between Messrs. Plunkett and Collins of the Massachusetts Board of Boiler Rules and D. S. Jacobus, F. R. Low, and I. E. Moultrop of the Boiler Code Committee reduced the points of difference between the two sets of Rules to 22, for which reasons for the changes were given.

On Dec. 2, 1919, a Subcommittee on Steam Piping was appointed, consisting of Arthur M. Greene, Jr., *chairman*, James Aston, Wm. H. Boehm, E. R. Fish, W. S. Finlay, E. C. Fisher, H. M. Houser, D. S. Jacobus, M. W. Kellogg, Wm. F. Kiesel, Jr., I. E. Moultrop, F. N. Speller, John A. Stevens, and Chas. Van Stone. This Subcommittee was directed to work in close co-operation with ASTM. As the standardization of valves had been stressed in February, 1920, the scope of the Subcommittee's work was expanded on March 18, 1920, to include valves and fittings. To avoid conflict with the work of the American Engineering Standards Committee the scope of the Subcommittee's work was limited to piping between boiler structures from the inlet side of stop valves. The Subcommittee, now known as the Subcommittee on Steam Piping, Valves, and Fittings, presented its report on proposed revisions on Sept. 27, 1923. The suggestions made covered 21 paragraphs, some of which were adopted as revisions.

Specifications for copper and brass were referred to the Conferring Committee with ASTM at the request of the Subcommittee on Piping, Valves, and Fittings on Oct. 27, 1921, and on March 2 of the following year. The P. M. Lattner Company reported that they had used copper tubes for which the Code gave no specifications. It was suggested that copper tubes be tested to destruction according to Par. 247. On Dec. 8, 1922, A. W. Carroll, assistant superintendent of the Raritan Copper Works, appeared before the Boiler Code Committee for the purpose of requesting the insertion of a specification on copper tubes in the Code. Dr. D. S. Jacobus spoke of tests made by the Babcock and Wilcox Co. to prove the reliability and behavior of copper tubes. Mr. Carroll was asked to present for consideration data that had been obtained for boiler plates and steel, cast-steel, and cast-iron headers and to determine what pressure was necessary to start leakage and movement of copper tubes in tube holes with the view of establishing the holding power of tubes. On Jan. 10, 1923, the proposed specification for copper tubes was submitted to the Boiler Code Committee and referred to the Executive Committee. In its report of Sept. 27, 1923, the Subcommittee on Piping, Valves, and Fittings established a formula for the gages of copper pipes after the Conferring Committee with ASTM had accepted the specifications for copper and brass pipe.

On April 20, 1921, the Boiler Code Committee eliminated Part II on Existing Installations from the Code and placed it in an Appendix, "Suggested Rules Covering Existing Installations, A-22 to A-53," which covered slightly more than 5 pages.

NEW REVISIONS

On Sept. 28, 1923, the Boiler Code Committee decided that it would not be necessary in the future to attempt revisions at four-year intervals. This decision was stated in the last paragraph in their report to ASME Council, which appeared as the introduction to the 1924 Edition of the Code. It closed with the sentence: "In the future the Committee will submit to you as promptly as possible any desired revision with recommendation that it be made an addendum to the Code to be included later on in the proper place in the Code."

MILL-STAMPING AND CODE SYMBOL STAMP

During this period of administration the question of the application of the mill stamp giving required information when transfers were necessary at the place of use was brought before the Boiler Code Committee, and the ruling was always that this transfer must be made by the manufacturer's agent at the mill. When the mill-stamping was covered by insulation on miniature boilers it was ordered that a record be taken from the mill test report for reference when required.

VIOLATIONS OF AFFIDAVIT BY BOILER MANUFACTURERS

A violation of its affidavit was reported in October, 1920, and on investigation, the offending company was found to have gone out of existence. In October, 1921, it was found that a company in one Code state was stamping and shipping improperly stamped boilers into another Code state. Action was taken to the effect that the Code Stamp must be placed on the boiler by the manufacturer.

REGISTRY NUMBERING OF STAMPS

The Boiler Code Committee, on March 2, 1922, directed that a new certificate and a consecutive number be issued to each company holding a stamp for the purpose of registration. This registry recorded the issuance of 222 stamps on April 25, 1924.

NATIONAL BOARD OF BOILER AND PRESSURE-VESSEL INSPECTORS

At the meeting of the Boiler Code Committee on Sept. 26, 1919, the Subcommittee on Inspection of Apparatus submitted a report and C. O. Myers, a member, explained the necessity of uniformity of methods among the inspectors of the different Code states. He asked if these inspectors should not consult together and form an organization which would be capable of handling and settling all questions of procedure in the application of Code rules. J. E. Scott suggested that the members of the Subcommittee present meet to discuss this matter as it was urgent. He proposed that a meeting be held that afternoon. At the meeting attended by J. E. Scott, *chairman*, Charles E. Gorton, J. C. McCabe, C. O. Myers, James Neil, and E. R. Fish, Ruling No. 1 was reported on the fair and equitable test of a sample of welded open-hearth-steel pipe to determine whether it came reasonably within the Code under Par. P 30b when the mill test was available.

This ruling was prepared by Messrs. Scott, McCabe, Myers, and Neil. This led to the suggestion that an organization of the chief boiler inspectors of all states or political divisions adopting the Code be set up, to be called the National Board of Boiler and Pressure-Vessel Inspectors. Headquarters were offered by Charles E. Gorton, chairman of the Administrative Council of the American Uniform Boiler Law Society at 253 Broadway, New York, N. Y. In October Mr. Gorton reported on the initial steps which had been taken and said that these were important to the activities of the Boiler Code Committee. He presented the draft of a letter to the ASME Council. Mr. Myers suggested that care should be exercised as the action should express the views of the American Boiler Manufacturers Association as well as those of the

Boiler Code Committee. He noted that inspectors did apply the Rules of the ASME Boiler Code but that there might be conflicting rulings by different inspectors. There should be new forms of organization to deal with matters of common interests, such as those on the examination and licensing of state inspectors for uniform action. The Conference Committee should be the agency through which co-operation might be secured. Rules of procedure which had been prepared by a Subcommittee were included in the letter to the ASME Council. These included: (1) Conference Committee of the Boiler Code Committee shall constitute the National Board of Boiler Inspectors; (2) the Boiler Code Committee should refer to the National Board all matters falling within the province of the National Board when there was a question of doubt with respect to the interpretation of the Code; (3) the Boiler Code Committee would suggest that a similar procedure to that employed by the Boiler Code Committee should be followed by the National Board, i.e., a letter ballot on decisions and, on one or more adverse criticisms, the action would be referred back to the Board for further action, but at a meeting a unanimous vote on the reference would not be required so that a minority could not block action. The Boiler Code Committee also suggested that the National Board submit to it a copy of any action sent to letter ballot.

A group of inspectors, Chas. H. Garlick of Allegheny County, Pa., J. C. McCabe of Detroit, Mich., C. O. Myers of Ohio, James Neil of Pennsylvania, and Joseph F. Scott of New Jersey, met in New York City on Dec. 2, 1919, to form a temporary organization with Mr. Scott as chairman, Mr. Neil, vice-chairman, and Mr. Myers, secretary and treasurer.

In June, 1920, Mr. Myers addressed a meeting of the American Boiler Manufacturers Association on the reasons for its formation, the purposes, and the method of operation of the National Board of Boiler and Pressure Vessel Inspectors.

The actual formation of the National Board resulted from a meeting held in Detroit, Mich., Feb. 2–3, 1921, at which practically all states and cities of the United States interested in steam-boiler regulation were represented. At this meeting the first Constitution and By-Laws were officially adopted to bring about its objectives. The National Board became an effective organization in later years in bringing about uniformity. The conference was more successful than the similar one called for boiler inspectors by Captain McClellan in St. Louis in 1889 mentioned in the first chapter.

On Nov. 17, 1920, the ASME Council authorized the National Board of Boiler and Pressure Vessel Inspectors to appoint one member to the Boiler Code Committee, with the understanding that he would remain a member as long as he was on the National Board or was an official charged with enforcement of regulations concerning boilers or pressure vessels of cities or states which had adopted the Code. C. O. Myers became the first member of the Boiler Code Committee to represent the National Board.

INTERNATIONAL AFFAIRS—MISCELLANEOUS SUBJECTS

During the early part of this period, Charles E. Gorton stressed the importance of extending information of the Code to foreign countries to inform them of the rules under which boilers were built in the United States so as to stimulate foreign trade (April 1, 1919). Later he urged the translation of the Code into Spanish.

On a number of occasions letters were received from the American Standards Association suggesting that the Boiler Code Committee be placed under their rules. In reply to the ASME Council's request for advice, the Boiler Code Committee pointed out that it was a Society organization which was able to act promptly through the ASME Council and was not governed by such rules as those of ASA and hence it could not accept sponsorship for Codes or activities of the American Standards Association. It was willing to co-operate on request.

The matter of rotation in membership of the Boiler Code Committee on a basis similar to that of ASME standing committees was brought again to the ASME Council and the Committee in October, 1922. The work and method of work of the Boiler Code Committee was explained as it had been done in the early days of the Code and the policy of rotation of membership was considered to be inadvisable. The Boiler Code Committee remained a Special Committee of the ASME Council, subject to annual appointment.

AMERICAN MARINE STANDARDS COMMITTEE

The U. S. Department of Commerce advised the Boiler Code Committee that it had formed the American Marine Standards Committee to define the kinds and characteristics of piping used on ships and to recommend specifications and also a committee on rules for boilers and pressure tanks to unify the requirements of the Steamboat Inspection Service and the Classification Societies. For the purpose of maintaining close contact between the work of the Boiler Code Committee and the Commission, co-operation was requested. A subcommittee of three to co-operate with American Marine Standards Committee was approved by the Boiler Code Committee on May 2, 1924.

PERSONNEL

On the death of Prof. R. C. Carpenter, Dean M. E. Cooley was appointed on April 22, 1920, to fill his place on the Boiler Code Committee. He resigned June 23, 1921. N. A. Carle, of the Public Service Company of N. J., was appointed on April 12, 1921, to fill the place of the late H. G. Stott. Wm. B. Reed was appointed to succeed his brother R. R. Reed, Oct. 20, 1922.

Two of the members of the original Advisory Committee, Wm. F. Kiesel, Jr., and H. H. Vaughan, resigned on Sept. 15, 1924. These men were appointed as representatives of the ASME Railroad Committee. Both were active in the general work of the Boiler Code Committee because of their knowledge and experience and each took an active part in the preparation of the Code for Boilers of Locomotives.

Attendance at meetings of the Boiler Code Committee, averaging 11 members or slightly under 50 per cent, had caused concern during these six years and various plans had been suggested to improve attendance but none was effective. One action taken to expedite work required that reply votes on interpretations or criticism must be returned within ten days.

The members were polled to determine the most suitable day or days of the week and month on which to hold meetings.

CHANGES IN FORM OF CODE ISSUED

The Boiler Code Committee voted on Jan. 19, 1920, to confine ballots on Cases to the members of the Committee, and on June 27, 1923, it voted to make the new Code of 1924 of pocket size, $5^{1}/_{4}$ in. $\times$ $7^{3}/_{4}$ in., printing Section I, Power Boilers, Section II, Material Specifications, and the Appendix in one volume, and omitting the recommendations on repairs by welding. Before printing, however, Section VI, Rules for Inspection, was added. Section III, Boilers of Locomotives, Section IV, Low-Pressure Heating Boilers, and Section V, Miniature Boilers, were published separately as they were issued.

On Oct. 1, and Dec. 1, 1924, the Boiler Code Committee authorized the use of materials under the specifications of the 1918 Edition of the Code provided they were ordered before the approval of the new Code on March 19, 1924.

Throughout these years interpretations were published in MECHANICAL ENGINEERING and also issued in pamphlet form, while all revisions were published in MECHANICAL ENGINEERING so that industry was informed of all actions affecting the Code.

Stronger Engineering Graduates

(*Continued from page 877*)

munity, between books and life as Sir Walter Moberly does at St. Catherine's. We call them "professional-development conferences" because they bring both science and the humanities into a professional focus.

Industrial interviewers who come to hire seniors are already remarking that this group seems to show a maturity of outlook and judgment greater than usually found among seniors.

It cannot be claimed that such conferences infallibly will insure that all students will build a rational life view based on justice and reason, but for our American educational system it at least makes that achievement possible. Our present-day emphasis on specialization makes a step in this direction necessary.

URGENCY OF THE CASE

Belief in justice, reason, and truth are the only foundations for these philosophies. Once we of the western democracies suspect that justice and reason are the out-of-date ideologies of a bourgeois age, mere screens for selfish interests hiding behind them and, indeed, sources of confusion and weakness to anyone who would trust in them, democracy is through.

The communists teach that the only real forces in life are economic interest, power, and subconscious desire. Justice is nothing but the will of one section; and there can be nothing higher than the longing for material benefits—so that to talk about higher missions is just foolishness or deceit. As Professor Polanyi[1] points out a generation has grown up full of moral fire and yet despising reason and justice. Hatred and class war thus become the means of liberating men from the delusions of truth and compassion. The Russian youth disbelieves in public morality in the way we disbelieve in witchcraft. It is not that he has never heard of it, but that he thinks he has valid grounds to assert that such a thing cannot exist. If you tell him the contrary, he will think you peculiarly old-fashioned, or simply dishonest.

For educators the problem is simple: How can young men be aided in building a rational life view based on justice and truth? The professional-development conference is one method that works.

Manpower Utilization and National Security

(*Continued from page 896*)

order to reallocate them to less highly skilled persons to the maximum possible extent.

CONCLUSION

During the period of approximately two years of its existence the Engineering Manpower Commission of Engineers Joint Council, either on its own or in co-operation with other agencies, has undertaken the following activities:

(1) Offering assistance to governmental bodies and groups responsible for making and administering policy relating to the conservation and utilization of engineers and scientists.

(2) Providing help and guidance to both industry and government on other problems relating to the conservation and utilization of engineering and scientific skills.

(3) Disseminating information on the nature of engineering and the role it plays in our economy.

(4) Striving to prevent future shortages in engineering graduates by co-operating with the Engineers' Council for Professional Development and others in encouraging qualified high-school graduates to consider the opportunities in engineering and science.

(5) Advising governmental agencies and the colleges on problems relating to the deferment of engineering students from military service.

(6) Advising employers of the conditions under which deferment of engineers and scientists may be secured and of the procedure to be followed in such cases.

In furtherance of this program, we wish now to pledge our support of all efforts to assure in industry, government, and other segments of our economy, the same zeal and intelligence in selection, training, and utilization of technical manpower that we are here urging upon the military establishments; for in such measures, in our opinion, lies the opportunity for maximum contribution of the technical professions to national security.

[1] "The Logic of Liberty," by M. Polanyi, London, England, 1951.

Atomic-Energy Report

THE Twelfth Semiannual Report of the United States Atomic Energy Commission, issued recently, covers those major velopments of the period January to June, 1952, in the atomic-energy program which, under the requirements of national security, may be publicly reported.

While the schedules of production from existing facilities, and of research and development work under current contracts were maintained, the building of new facilities accelerated until by mid-year almost three per cent of the nation's construction labor force was at work on atomic-energy construction projects.

The Congress, in the supplemental appropriation act signed by the President on July 15, approved a further expansion of atomic-energy production capacity which would eventually add 3.5 billion dollars to the nation's investment in atomic-energy plants.

Development of reactors, the machines which release nuclear energy at controlled rates, was carried forward. Specific items of progress in research in the physical, biological, and medical sciences are also covered.

Although, for reasons of security, it is impossible to specify the record of accomplishment in weapons development, it may be stated that substantial progress was made. The major factor which came to public attention was the series of tests of nuclear devices leading to weapons development which took place in April, May, and June, at the Nevada Proving Ground. For the first time, a test detonation—one of this series—was witnessed, under conditions safeguarding security of restricted data, by representatives of state, federal, and territorial civil-defense agencies, press, radio, motion pictures, and was transmitted by television.

The report deals also with the salient developments in the first basic aspect of the program—provision of the necessary supplies of raw materials. It sums up the advance of the construction program, points out the types of problems encountered in community affairs at the major sites and the solutions reached, and reports actions taken in the fields of new legislation, finance, patents, labor-management relations, safety and fire protection, security operations, and information issuance.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Technical Editor*

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

High-Energy Accelerators

THE building of a high-energy accelerator less massive than the Brookhaven Cosmotron, yet producing atomic particles with energies more than 10 times as great as those delivered by the Cosmotron, may now be possible.

Such is the implication of a new scientific principle worked out by a team of physicists at Brookhaven National Laboratory, Upton, N. Y. The principle, or theory, describes a method of focusing atomic particles in flight so they group themselves in a beam so narrow they can travel in a tube of relatively small cross section. The smaller the dimensions of the tube, the less massive the electromagnet required to guide the particles in the circular path of the tube.

Projecting the theory to possible future design, the physicists believe that a 30-billion-volt machine would require a magnet of half the weight of the 2200-ton magnet of the Cosmotron, which is designed to produce 3-billion-volt particles. The Cosmotron magnet units have a cross section of 8 ft × 8 ft, as compared to dimensions of about $1^1/_2$ ft × 2 ft for a future machine. However, the 30-billion-volt machine would have 10 times the 60-ft orbit diameter of the Cosmotron, and the radiofrequency system of building up the energy of the particles would be more complex.

The same methods could be applied to a 100-billion-volt machine, with magnet units of about the same cross section but of three-times-larger orbit diameter, or nearly half a mile. Accelerators of such dimensions would probably be housed in large, circular, doughnut-shaped buildings, and thick shielding walls would be necessary to protect personnel from high-energy radiation.

Although plans have not yet been made for actually building such machines, the theory and its possible application to a hypothetical 30-billion-volt accelerator have been formulated.

The new focusing theory was stimulated by experience gained in operation of the Cosmotron, which on May 20, 1952, yielded the first billion-volt atomic particles ever produced by man. Such particles begin to compare in energy to the primary cosmic-ray particles, which penetrate the outer atmosphere of the earth.

By studying the products of disintegration of nuclei bombarded by such particles, scientists can learn new facts about the mysterious forces which bind particles together in nuclei. The greater the energy of the bombarding particle, the greater is the fragmentation of target nuclei—hence the advantage in accelerating particles to higher and higher energies.

By using multibillion-volt particles as projectiles, it is possible to penetrate the neutrons and protons which are the fundamental building stones of the nucleus, to transmute one into another, to convert energy into nuclear particles, and to reveal new fundamental properties of matter.

Gaseous-Diffusion Plant

THE U. S. Atomic Energy Commission recently announced that it will construct a new gaseous-diffusion plant for the production of uranium 235 in Pike County, Ohio, about 22 miles north of Portsmouth, Ohio, with the Goodyear Tire & Rubber Company of Akron, Ohio, as operating contractor. About 6500 acres of land will be acquired.

The gaseous-diffusion process, designed to separate fissionable uranium 235 from nonfissionable uranium 238, is one in which uranium hexafluoride in gaseous form is pumped through thousands of extremely fine barriers which have literally millions of tiny holes per square inch. Since U-235 atoms are slightly lighter and therefore travel slightly faster, they strike the screens and pass through the holes with greater frequency than do U-238 atoms. This process gradually separates the U-235 atoms.

Operation of the plant will involve no appreciable radiation hazards. In the six years that a similar plant has operated at Oak Ridge, Tenn., not a single employee has suffered a radiation injury. A gaseous-diffusion plant operates with no more than normal industrial hazards.

Preliminary design calls for a plant estimated to cost about $1,200,000,000. It will require up to 400,000 kw of power—to be supplied from existing facilities—for early operations and new power plants will be built to supply the maximum of 1,800,000 kw needed when the entire plant is in operation.

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources: i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

Although portions of the plant will be placed in operation as soon as completed, construction of the plant as a whole is scheduled to take about four years. A peak of about 30,000 workers will be necessary for a short period. Except possibly for one year, average construction employment is not expected to exceed 17,000.

Lightweight Diesels

A FAMILY of lightweight, high-speed, water-cooled, four-cycle, industrial-type Diesel engines—Packard Series 142—recently announced by Packard Motor Car Company, Detroit, Mich., is currently in production for the U. S. Navy in two models—a 6-cylinder and a 60-deg V-12, equipped with turbochargers, and rated 300 and 600-bhp, respectively, for continuous duty at 2000 rpm. Of all-aluminum construction, these engines are reported to have the lowest specific weight (lb per bhp) of any Diesel engine in production today. The 6-cylinder engine weighs 2200 lb; the V-12, 3250 lb. On this basis the six has a specific weight of 7.34 lb per bhp; the V-12 is 5.41 lb per bhp.

The introduction of these engines will enable Packard to re-enter the marine-engine business some time in the near future when the military program makes it possible to turn attention to normal production. Because of their lightweight these engines also should be a natural for industrial-power applications, for large trucks and buses, and for off-highway vehicles.

Distinguishing characteristic of these engines is the adoption of a basic standardized cylinder assembly design which promotes complete interchangeability of most major parts. The basic cylinder is of 142 cu in. displacement with a bore of $5^3/_8$ in. and stroke of $6^1/_4$ in.

Among the major interchangeable parts common to all engine models are: Cylinder head and wet liner assembly (integral on Packard engines); pistons, wrist pins, and piston rings; intake and exhaust valves, valve springs, and valve guides; main and camshaft bearings; and other minor parts. An uncommon feature is complete interchangeability of crankshafts on both the six and V-12. In addition, fuel injectors and multiplunger fuel pumps are interchangeable.

Noteworthy features of these engines are as follows: (1) Use of a basic cylinder assembly, (2) interchangeability of major parts, (3) lightweight all-aluminum structure, (4) unique combustion system, employing a spherical precombustion chamber, (5) ease of maintenance.

Combustion-chamber design, unique feature of these engines, employs a spherical precombustion chamber which is precision-cast in the alloy-steel cylinder head. It is located directly over the center of the piston and provided with a removable multiple-orifice burner which ejects the hot gases directly onto the dome of the piston. A pintle-type fuel injector mounted in the cylinder head injects metered quantities of fuel directly into the precombustion chamber where ignition starts and peak pressure occurs.

When the burning mixture is ejected onto the piston in the main combustion chamber, the dispersing cone on the piston dome causes the high-velocity jet to mushroom and the resulting high turbulence mixes the fuel and compressed air thoroughly to promote complete clean burning of the fuel.

Since the peak pressure in the main combustion chamber is lower than that in the precombustion chamber, a feature of this design is that it facilitates lightweight high-speed operation and quick-cold-starting. In addition, fuel-line pressures to the injectors are considerably lower than usual practice.

The central fuel system consists of a multiplunger fuel pump of six-cylinder type—one unit for the six, two units for the V-12. Fuel supply is regulated by a hydraulic governor, mounted externally. Additional safety is afforded by the installation of an overspeed trip governor.

The massive cylinder block and crankcase is an integral casting of aluminum. The oil pan is of aluminum, as are the valve covers, timing-gear cover, supercharger, intake and exhaust manifolds, accessory housings and cover plates, pistons, and other detail parts.

The cylinder block is an extremely rigid structure with massive bulkheads at the main bearing line to assure rigidity. In addition, the main bearing caps are tied into the structure by means of long through-bolts which extend through the caps to bosses on the outside.

The removable cylinder heads are of cylindrical shape, made of alloy-steel precision castings, and fit within bores at the top of the block. They are held in place by means of a threaded plug. Unusual feature is the fact that the long wet-type cylinder liners are welded to the cylinder heads to make an integral one-piece assembly which is readily replaceable.

The standard cylinder head is fitted with four valves—two intake and two exhaust—driven by individual camshafts, two per bank. Exhaust valves are sodium-cooled and all valves are Stellite-faced and operate in Stellite-faced seats. Valve springs are of nested damping type, their mounting being quite unique. The valves are caged in a cylindrical barrel, integral with the valve guide. A barrel-type tappet, fitting over the springs, is slidable within the

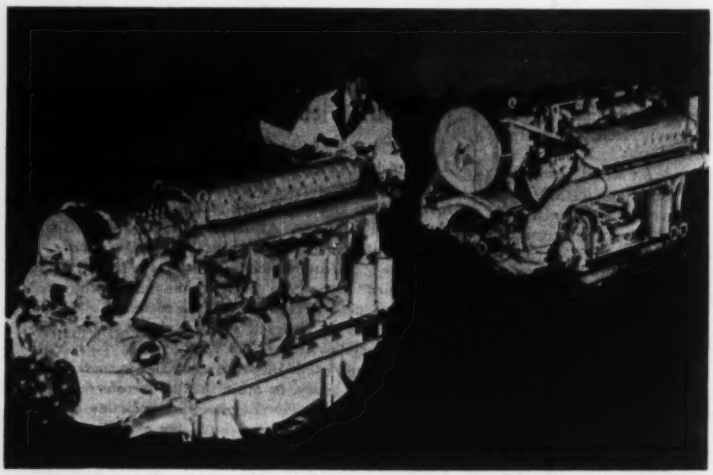


FIG. 1 STRAIGHT SIX (*left*) AND V-12 (*right*) MARINE DIESEL ENGINES ARE TWO OF PACKARD'S NEWLY DEVELOPED FAMILY OF LIGHTWEIGHT DIESELS BEING MADE FOR THE U. S. NAVY

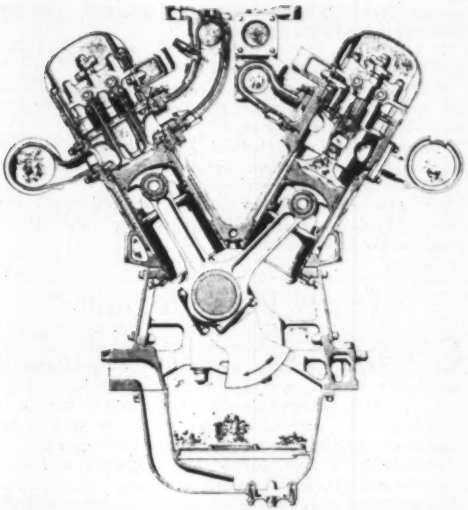


FIG. 2 TRANSVERSE DRAWING OF V-12 PACKARD DIESEL ENGINE SHOWING THE COMPACTLY ENGINEERED VALVE, PRECOMBUSTION CHAMBER, AND PISTON

valve guide barrel. A button, fitting over the valve tip and contacting the inner face of the tappet, provides for valve clearance adjustment.

Pistons are of permanent-mold aluminum alloy, of massive design with a heavy formed dome cavity. They are fitted with five rings, four above the wrist pin, one in the skirt. The top three are compression rings, the top ring being chromium-plated. The lower two are special-tapered oil-control rings.

The seven-bearing crankshaft is an alloy-steel drop forging, counterweighted and fully balanced. It is nitrided to promote long life. A viscous-fluid damper is used. Main bearings are of steel-back interchangeable type with a silver-bearing coating on the steel. This is protected against scuffing and corrosion by a thin overlay of high-lead and tin.

The turbocharger, mounted at the front of the engine, is fitted with an air cleaner. The exhaust gases are directed to the turbine end of the supercharger through a special smooth-flow exhaust manifold. The manifold is water-jacketed to reduce heat radiation around the engine. Because of this, special arrangements are made to reduce heat losses in the exhaust gas stream to the turbocharger. To this end, the exhaust manifold is fitted with a stainless-steel tube, the diameter of which is such as to provide a dead air space between it and the inner surface of the cast manifold.

TABLE 1 COMPARISON SPECIFIC WEIGHT (LB PER BHP) PACKARD SERIES 142 DIESEL ENGINES WITH OTHER WELL-KNOWN MAKES

Make	Bhp (continuous rating)	No. of cylinders	Shipping weight (lb)	Lb per bhp
Packard	300	6	2200	7.34
Packard	600	V-12	3250	5.41
A	520	24	12,600	24.23
B	348	6	13,000	37.35
C	374	V-12	14,000	37.43
D	345	V-8	4800 (industrial)	13.62
E	350	V-12	5700	16.28
F	335	6	12,000	35.82
G	185	6	4600	24.86
H	152	6	4310	28.35

The engine is fresh-water-cooled, using sea-water-type heat exchangers. Water circulation starts at the lower end of the cylinder jackets and progresses upward to the cylinder head, then out through a header.

Full pressure lubrication is provided to all bearings and other major points. Cylinder-wall lubrication, as well as wrist-pin lubrication is effected by splash feed. A filter and oil cooler are provided.

Quick-starting under cold-weather conditions is afforded on the Navy engine by means of air motor starters. However, electric starters can also be used.

Ceramic Coatings

SOME of the stainless steels used in aircraft exhaust systems tend to absorb carbon under severe operating conditions. This causes precipitation of carbides at or near grain boundaries, which may result in failures of exhaust parts.

The National Bureau of Standards, under the sponsorship of the National Advisory Committee for Aeronautics, has demonstrated in recent laboratory tests that certain NBS ceramic coatings successfully prevent this undesirable carbon absorption. Investigated were several NBS ceramic coatings, including types A-417 and A-19H, applied to three 18-8 stainless steels: AISI types 304, 321, and 347. Coated and uncoated specimens of the alloys were subjected to strongly carburizing conditions at 1350, 1500, and 1650 F.

Earlier NBS studies have demonstrated the ability of ceramic coatings to protect alloys from oxygen and lead bromide, but until now there have been no reported studies of the effectiveness of the coatings in preventing carbon penetration.

In the present study, small sheets of the various coated and uncoated alloys were packed in an alloy box with a commercial carburizing compound. The box was then placed in a furnace and slowly heated to one of the three selected temperatures. After 4 hours at this temperature, the box was removed from the furnace and allowed to cool in air.

Specimens thus treated were examined for significant changes in surface appearance and were then sectioned, etched, and examined metallographically. Although some of the coated specimens showed blistering, spalling, or wrinkling, in no case did the metal become exposed. Most of the uncoated specimens gave evidence of carbon absorption to depths as great as 0.007 in. below the surface. In most cases, however, the ceramic coatings completely prevented the absorption.

Of those studied, NBS ceramic coating A-19H proved most effective in preventing carbon absorption under all test conditions. However, the extreme severity of the test carburizing conditions would probably never be encountered in the practical operation of aircraft exhaust systems, and any of several coatings might well prove fully satisfactory in service. Service testing of coated exhaust parts is probably the only really valid method now available for establishing the relative merits of different ceramic coatings.

New Jet Engine

THE development and placement into production of the world's most powerful qualified turbojet aircraft engine has been announced by the U. S. Navy and Westinghouse Electric Corporation. It develops thrust equivalent to approximately 25,000 hp at today's jet flight speeds.

The new power plant is said to be the first jet engine in the

world to provide constant speed drive for airplane accessories as an integral part of the engine, thereby permiting designers to make substantial savings in weight and space in new planes, both vital factors in maintaining aircraft superiority.

The new aircraft power plant has just successfully completed the Defense Department's grueling 150-hour qualification test, which all new engines must pass to be eligible for quantity production. The test was equivalent to more than 75,000 miles of actual flight.

Several new fighter planes, all of which are scheduled for early production for the U. S. Navy, are expected to be powered by the new engine. These will include the McDonnell F3H "Demon" and the Douglas F4D "Skyray."

The new engine is an outgrowth of the original Westinghouse J40 engine which, when announced last year, was the most powerful turbojet in the world to qualify for production.

The tremendous power of the new J40, it was revealed, is partly developed through the use of an afterburner which reheats the exhaust gases after they leave the turbine but before they emerge as a jet stream.

The new engine is of the axial-flow or straight-through design. Almost 25 ft long and about 40 in. in diameter, it is exceptionally light and produces more thrust per square inch of frontal area than any other turbojet.

It is $2^1/_2$ times as powerful as the combined four engines on a B-29 Superfortress, but its weight, approximately 3500 lb, is less than that of only one of the famous bomber's engines and propellers. More powerful versions of the J40 are under development, it was disclosed.

Substantial amounts of two critical metals—columbium and cobalt—have been eliminated in the new J40. Indications are that even greater savings of these and other scarce materials will be effected in newer versions of the engine.

A new low-cost fuel especially developed for use in high-flying jets and designated as "JP-4," was used throughout the qualification test, engineers reported. The new J40 thus becomes the first Navy-sponsored turbojet to qualify on the new fuel.

Intercontinental Jetliner

ACCORDING to a special issue of the *Handley Page Bulletin*, September, 1952, Handley Page Ltd., Cricklewood, London, N.W. 2, England, has on its drawing boards a great new high-speed jet-powered airliner—the H.P. 97—with a load-carrying capacity of 50,000 lb.

The *Bulletin* states that it will fly as many as 150 passengers economically over very long distances at almost sonic speeds. Enjoying vibrationless flight, all will be seated in luxurious cabins and outside the jet "noise cone."

The range of the H.P. 97 will make possible nonstop trans-Atlantic flights over the 3455 miles between London and New York. Its speed through the stratosphere will enable three such journeys to be made in a 24-hr day.

On eastbound flights 122 passengers and their baggage will be carried in $6^1/_2$ hr; westbound there will be five fewer aboard and, because of the prevailing winds, the journey will take an hour longer.

Direct operating cost on this blue-ribbon route will be one penny per passenger mile. Three of these jetliners will carry more people across the Atlantic in a year than either of the Cunard's mammoth Queens.

From Cairo to Karachi, the H. P. 97 will cover the 2210 miles in $4^1/_2$ hr with 148 passengers (each at 0.7 pence per mile), their baggage, and 8500 lb of freight and mail.

In eight hours it will carry 94 passengers and their luggage over the 3915 miles between Sydney and Singapore. Cost per passenger mile will be 1.8 pence.

Two alternative seating layouts are planned for the double-bubble, two-deck fuselage of the H.P. 97.

In the luxury version, seating 94 people, four individual seats are spaced across the width of the upper deck, two being on each side of a central gangway.

For tourist travel with 150 passengers, mostly triple seats are fitted on either side of the gangway and there is accommodation for 16 passengers in the lower deck.

Aft of the stewards' galley on the lower deck are dressing rooms and toilets and, aft again, there is a bar in the spacious lounge of the luxury version.

Heavy-Press Program

CONSTRUCTION of 17 heavy presses—eight extrusions and nine forges—ranging from 8000 to 50,000 tons capacity, has begun at various points in the United States under the direction of the U. S. Air Force, according to the Defense Production Administration. Within the next few years these giant machines will be turning out large aircraft and engine parts in a fraction of the time required by our present production methods, and at tremendous savings in dollars.

In scope and magnitude of operation these presses will do away with a great deal of the present uneconomical "bits and pieces" assembly, and turn out whole wing sections, ribs, frames, and other structural members in one motion. Spars—for example, which now have to be laboriously fashioned out of many pieces of metal—will be stamped out in a single operation.

The Air Force is handicapped by limitation of the present large press equipment. There are only three in the United States. One is located at the Wyman-Gordon plant in North Grafton, Mass , one at the Alcoa plant in Cleveland, Ohio, and the third at Bohn Aluminum and Brass Company, Adrian, Mich. The first is of American construction and the others were brought from Germany by the Air Force in its determination to break the production bottleneck.

Using the equipment now at hand, as long as six months is necessary to complete a set of airplane dies. Existing die-block capacity is estimated at from 40,000 to 50,000 tons annually, and the majority of this is capable of producing only the smaller-sized blocks. It has been estimated jointly by representatives of the forging industry and the Air Force that when the heavy-press program is operating at an efficient level the annual die requirement alone may well run from 50,000 to 75,000 tons, and these blocks may average in excess of 20 tons each.

In its endeavor to get the heavy-press program going, the Air Force arranged for representatives of the entire aviation industry—engine as well as airframe manufacturers, plus men from companies which would build the presses and those which would operate them—to study the manifold problems down to the last detail. A comprehensive investigation was made; 17 airplanes now in production were evaluated, and the final conclusion was that the time had come to change to the new method of production.

Before the study was made by the Air Force, there was very little information available on heavy presses. There were many serious questions for which no one had an answer. The cost was unknown. It was not known whether a furnace big enough to heat-treat the mammoth ingots could be built, or whether such huge forges could be made steady enough so there would be no deflection to destroy their accuracy. Neither was it known whether the forgings could be checked and straightened or whether they could be machined and put into

the plane when finished without a lot of extra expense to remove surplus metal. These questions were all answered satisfactorily and are contained in the report the aviation industry presented to the Air Force.

Heavy presses are readily adaptable to the handling of new shapes, and will last many years. While modifications on airplanes are being made all the time, these changes apply mainly to certain aspects of the plane's performance and requirements. The F-80 Shooting Star was started in 1942 and has gone through a dozen model changes, but the basic structure of the aircraft has not changed. Even in the case of an entirely new design, the only part of the press which would have to be changed would be the die block. New die blocks could be used on the same press, and the same handling equipment would be used in all the other machining operations.

Research with magnesium and the newer high-strength aluminum alloys discloses that in no other way can these metals be so efficiently handled. While they tend to shatter under the impact of the hammer blow—the oldest of the metalworking methods—under a press they flow.

Versatile Core Boxes

MANY types of foundry castings contain cylindrical holes, and it is usually more economical to form the hole at the time the casting is made than to drill it afterward. To form such a hole, a cylindrical core is properly located in the mold before the casting is poured. These cores consist largely of sand, and are easily knocked out after the castings have cooled. Hollow boxes of suitable dimensions are used to form the necessary cores. Many different cores are required for the variety of castings called for in foundry practice, and a correspondingly large number of cylindrical core boxes are acquired and accumulated by many foundries.

At the National Bureau of Standards a simplified system of cylindrical core boxes has recently been devised. A set of 14 boxes for cores ranging in diameter from $^3/_8$ in. to 2 in. in $^1/_8$-in. steps, has been made for the NBS experimental foundry. There is one box for each diameter core, and the length of each box has been fixed at the maximum likely to be required for a core of that diameter as shown by experience. Shorter cores can be cut from full-length units, or can be made by placing cylindrical pieces of wood of the proper length in the core-box cavity. When a core with a tapered end is required, a brass insert having a standardized taper is placed in the core box.

The NBS core boxes are filled and rammed with conventional sand-and-binder mixtures. A typical mixture contains, in addition to washed silica sand, about $1^1/_2$ per cent of linseed oil, $^1/_2$ per cent of corn flour, and $3^1/_2$ per cent of moisture. After the sand has been formed in the core box, it is carefully removed and baked for an hour or more at about 400 F to harden it, in accordance with usual practice.

Though the boxes were made of wood at NBS, metal might well prove more satisfactory in production work. Brass was used for the tapered inserts. Each insert is $^1/_{32}$ in. smaller in diameter than the core box with which it is used, to facilitate placing it at the bottom of the box prior to ramming the sand. Tapers were standardized at 15 deg, instead of the wide variety of tapers encountered in common practice. A standard vertical length for the tapered insert was also adopted for each core diameter.

When cores are used in making castings, the ends of the cores must fit properly into the two halves of the mold. The mold is therefore formed with wooden "core prints" attached to the casting pattern. These core prints are solid blocks of the same size and shape as the ends of the cores. When the pattern and prints are removed after the mold has been formed around them, the mold is left with holes of proper diameter, depth, and taper to accept the ends of the cores. Because taper and length of the core ends are standardized in the NBS system, it becomes possible to use a master set of core prints, which further simplifies foundry operation.

The 14 versatile NBS core boxes take care of the great majority of core requirements at the NBS experimental foundry, largely eliminating the need for making special boxes for new jobs. Foundry operation is thus simplified and made more economical. Because of its inherent advantages, other foundries may find the NBS system useful, with or without modification.

Water-Purification Unit

A NEW truck-mounted electrical water-purification unit, which is capable of treating, clarifying, filtering, purifying, and distributing 2400 gal of water an hour in temperatures as low as −40 F, was demonstrated at Richmond, Va., recently, by the U. S. Army.

The unit, which can easily be transported on a cargo-type plane to combat zones, contains several inventions and numerous developments resulting from years of basic and applied research at the Engineer Research and Development Laboratories, Fort Belvoir, Va.

Heart of the unit is an ultra-high-rate solids contact water conditioner called an erdlator. This device is connected in series with diatomite filters, and the combination not only removes silt and destroys bacteria, but also provides positive physical barriers to the passage of organisms which cause dysentery and schistomiasis, a serious water-borne disease found in the Far East.

Polluted water can be pumped into the unit and chemically and physically treated and discharged as potable water in approximately 20 minutes. Its excellent performance and short detention time is attributed to the use of a material which is almost universally available and costs less than $12 a ton.

Only one man is required to operate the unit and it can be put into operation by three men in less than 90 minutes after arrival at a selected site. Equipped with its own power source, it can be operated in total blackout. The only noise audible is from the engine driving the generator.

Photoelectric Scanner

A MECHANICAL "eye" for automatic detection and inspection of surface flaws in parts on the production line, has been developed by Battelle Memorial Institute, Columbus, Ohio, and the Magnaflux Corporation, Chicago, Ill.

The device, known as a photoelectric scanner, is expected to be particularly useful in the manufacture of automotive, aviation, railway, and ordnance equipment, where 100 per cent inspection of critical parts is vital to performance and safety.

The new mechanical eye is intended to replace human inspection. It is expected that it will play an important part in insuring top-notch quality of parts and materials where high production rates are necessary.

By discovering defective materials and parts, and thereby eliminating further fabrication costs on defective items, the new device will also be helpful in reducing production costs.

The scanner, which inspects without destroying, joins the ever-widening family of nondestructive test methods that are serving a wide variety of American industries. It is designed for use in two particular types of nondestructive testing where

automatic processing and handling equipment are already available.

These two particular types of nondestructive testing, Battelle scientists explain, are known as the (1) "fluorescent magnetic particle," and (2) "fluorescent penetrant" methods.

In both cases, a fluorescent indicating material, applied to the test object, is attracted to the flaw. Scanning is mechanical by a revolving mirror in the optical system. Electronic devices, co-ordinated with the optical system, can be used to mark the flaw or have the defective part ejected from the production line.

Digital Automatic Computer

AN ELECTRONIC digital computing machine—one that not only tackles weighty problems but also "worries" about the accuracy of its solutions—soon will be used by the Armed Forces to help develop deadly guided missiles at a rate faster than any other nation in the world.

The machine is called "Raydac," an abbreviation of "Raytheon Digital Automatic Computer." It was developed by Raytheon Manufacturing Company, Waltham, Mass., for the Bureau of Aeronautics under contract with the Special Devices Center of the Office of Naval Research. The equipment was unveiled recently for the inspection of the press following final acceptance tests and prior to shipment to BuAer's Naval Air Missile Test Center at Point Mugu, Calif. There it will be used as an "intelligence center" to help analyze the behavior of missiles during test flights.

The solution of thousands of complicated mathematical problems involved in analyzing a single missile flight often requires the services of a team of workers performing a mass of calculations over a period of 20 to 30 days, according to Raytheon spokesmen. The new digital computer will be able to effect tremendous savings in costs and time by completing the same process in a matter of minutes. This important application of computer techniques was planned by the Navy's Bureau of Aeronautics and the Special Devices Center for use by the Departments of the Navy and Air Force in guided-missile development. Technical aspects of the Raytheon project have been administered by the Special Devices Center of the Office of Naval Research.

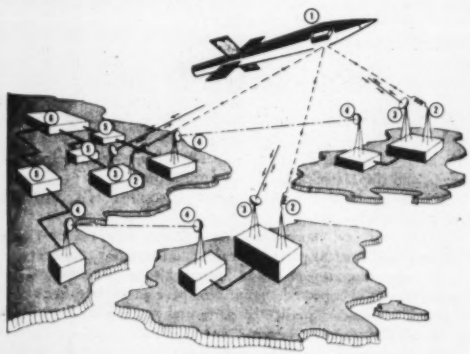


FIG. 3 HOW A MISSILE'S FLIGHT IS OBSERVED

[This diagram shows how a small transmitter in the missile (1) sends out information concerning the missile's behavior in flight, which is picked up by receiving stations (2). Radar tracking equipment (3) provides a double check on the missile's speed and course. These data are relayed over microwave links (4) to recording centers (5) for storage. It is then available for feeding into the computer (6) for analysis.]

The machine was said to worry about the results of its calculations because of a built-in "check-and-double-check" system which halts the equipment's operation the instant an error creeps into its computations. This ability of a machine to recognize and locate the source of its own mistakes has been brought to a high degree of efficiency in the new computer. All of the information that passes through the Raydac, and all of its calculations are verified by ten different types of accuracy checks. When an error occurs, the entire computation process is halted, and the location of the trouble is revealed to the operator by indicators on the control panel. However, all the work done up to that point is preserved so that the machine can continue where it left off. This checking system—said to be the most comprehensive ever devised—has two principal advantages. First, it eliminates the possibility of errors in the machine's calculations—errors which, if they were to remain undetected, could lead to costly miscalculations. Second, it enables the operator to clear up the trouble promptly.

The development of a guided missile involves the application of many highly complicated theories of physics, aerodynamics, electronics, and other sciences, engineers said. Construction of a missile requires the devising of intricate circuits, the prepara-

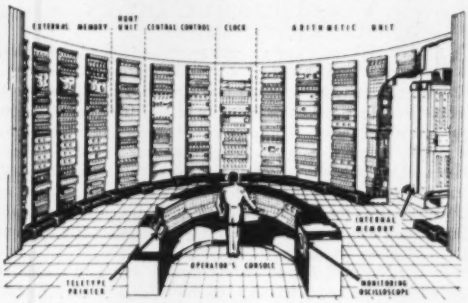


FIG. 4 COMPUTER CONTROL ROOM, SHOWING MAIN COMPUTER AND OPERATOR'S CONSOLE

(Shown at the left are the four external memory racks where information is fed into and out of the computer. Located here are the magnetic tapes and mercury "buffer" units which balance the low-speed external memory with the high-speed internal machine. Next is the hunt unit which literally hunts through the external memory for specific information required. Central control, the automatic control brain of the computer, issues all the orders required to completely process a problem once the machine has been started. To the right of central control is the clock which provides the intricate timing pulses required to keep the information circulating correctly throughout the machine. The arithmetic unit is the section of the computer which actually performs the calculations. Located behind the main racks is the internal memory containing the high-speed mercury storage. Finally, the operator's console contains the controls and lights necessary to start and stop the computer and investigate the status of the problem at any instant.)

tion of a mass of blueprints, and the development of servomechanisms and related devices for making the missile self-operating. Yet all of this careful development and precision construction serves no useful purpose, it was emphasized, until design engineers learn how the missile behaves while in actual flight.

The most valuable information provided by test flights concerns the functioning of the missile's "brain," "eyes," and "muscles." Such data are provided by electronic "inspectors." Some of these monitoring devices, located at ground observation posts, watch the missile's flight, while others—built into the weapon—check on what is happening inside the missile, from the instant it is launched until it reaches the end of its flight.

FIG. 5 A VIEW BEHIND THE SCENES, AS RAYTHEON ENGINEERS, TESTING THE RAYDAC, CONNECT THEIR OSCILLOSCOPES TO SPECIFIC POINTS IN THE MASS OF CIRCUITRY BACK OF THE NEW COMPUTER

For example, miniature transmitters in the missile send detailed reports concerning how fast it is traveling, the rate at which it is using up its supply of fuel, the temperature of the missile's jet engine, the angle of the missile's ascent and descent, and other data.

Below, on the ground, radar stations watch the path and the altitude of the missile on its course. As a double check on the inspectors inside the missile, the radar stations also observe the missile's speed and flight path.

Once a missile is launched, these inspection devices instantly go into action. Information begins to pour into the observation stations at a prodigious rate. In fact, it accumulates so rapidly that it is necessary to store the data on high-speed recorders. These recorded radio and radar signals constitute the basic flight information used later in analyzing the missile's performance.

When the Raydac is put into operation at Point Mugu, the recordings made during the test flight will be "coded"—that is, translated into mathematical language the computer can understand—then fed into the machine for almost instantaneous solution.

The Raydac, engineers said, cannot actually think, but it can compute at an incredible speed. It will produce 1900 additions, 1900 subtractions, 1100 divisions, or 1400 multiplications a second.

A knotty problem in the development of high-speed computers has been the devising of a "memory" system able to keep pace with the tremendous speed of the calculator itself. The Raydac designers solved this problem by use of a dual memory which transfers information between "low-gear" and "high-gear" sections, the latter supplying data and accepting results fast enough to match the computer's lightning calculations.

The Raydac has 5000 vacuum tubes and 18,000 germanium diodes. Although one of its subminiature tubes generates hardly enough heat to be detected, the machine has such a vast number of these tiny tubes that it requires a cooling system using enough refrigerant for 50 home refrigerators. It has several miles of wiring and consumes 25 kw of power, equal to that required for 500 50-watt light bulbs.

The Raydac is built into a row of 15 panels, totaling 44 ft in length, faced by an elaborate operator's control console. Yet, for all its size and complexity, the computer is actually compact —principally because it uses the latest subminiaturization techniques. A novel feature of the Raydac is the assembly of these subminiature components into small plug-in packages which can be replaced quickly in the event of a failure.

Magamp Regulation

A NEW high-speed regulating system for the excitation of synchronous machines was described to the technical press recently in New York, N. Y., by J. E. Barkel, Electric Utility Engineering, C. E. Valentine, Switchgear Engineering, and J. T. Carleton, Industry Engineering, Westinghouse Electric Corporation, East Pittsburgh, Pa. Heart of the system is a magnetic amplifier (Magamp) which has a shorter time delay than a rotating amplifier, and when used in connection with a self-excited exciter, provides a regulating system that has a faster response. A static device, the Magamp replaces the rotating amplifier and eliminates its brushes and commutator, with their attendant maintenance problems. This results, it was said, in a system that is fast, reliable, and requires little or no maintenance. The basic elements of the system are the same for any type of synchronous machine, so the Magamp regulator can be used with turbine generators, water-wheel generators, or synchronous condensers.

The Magamp system is an outgrowth of a comprehensive examination of the advantages and shortcomings of older systems. Analog-computer studies were used to analyze complicated circuits involving time constants of various magnitude, and the other variables associated with the operation of synchronous machines. The result of these studies is the regulating system illustrated in Fig. 6.

The synchronous machine has a self-excited main exciter; manual control of excitation is accomplished by adjusting the motor-operated field rheostat. This provides a manual control that is simple and easily understood by the operator.

The main exciter has two separately excited control fields that are energized by the power Magamp. Under regulator control, the motor-operated main exciter field rheostat is set manually to produce a base excitation for the synchronous machine. The power Magamp puts energy into either the boost or buck control field to raise or lower the excitation voltage to the value required to maintain a fixed machine terminal voltage. The combination in the main exciter of a self-excited field and separately excited control fields provides simple and effective control of the exciter voltage. There is a definite advantage over separately excited main exciters, because loss of the separate excitation does not seriously disturb the main unit under normal operating conditions. Operation continues with the excitation provided by the self-excited field, as under manual control. The use of separate fields to provide the buck-boost energy eliminates switching in the self-excited field circuit when changing from manual to automatic voltage control.

The four static components of the Magamp regulating system are shown schematically in Fig. 6. The reference component, energized from a separate a-c supply, develops the reference quantity used as a basis for comparison. At a-c supply frequencies of 70 and 140 per cent of normal, the reference error is less than 2 per cent. Variations within the usual operating

range of ± 0.5 per cent of the base frequency cause less than ± 0.1 per cent error. Thus the reference is ideal for water-wheel generators, which are subject to elevated frequency and voltage following load rejection and during runaway condition. The increase in synchronous-machine terminal voltage above the reference causes the regulating system to force down the excitation voltage and attempt to maintain approximately the predetermined voltage level even though overspeed has increased the frequency.

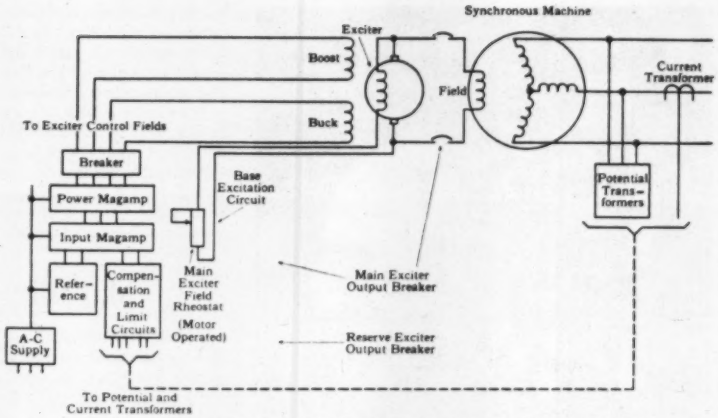


FIG. 6 SIMPLIFIED SCHEMATIC OF THE NEW MAGAMP REGULATION SYSTEM FOR SYNCHRONOUS MACHINES

The compensation and limit circuits are energized from the synchronous-machine terminal voltage through potential transformers, and from phase current through a current transformer. The compensation circuits provide reactive-droop compensation as required by the system and line-drop compensation. Reactive-droop compensation causes the proper distribution of reactive kilovars among machines that operate directly in parallel. Line-drop compensation causes the regulating system to maintain constant voltage at some point on the system remote from the machine being regulated.

An underexcitation limit is normally provided in the limit circuits for all synchronous machines. It prevents the regulator from reducing the exciter voltage, and consequently the synchronous machine excitation, to a point that would jeopardize the stability of the machine with the system. The lower limit of excitation can be adjusted as kilowatt and reactive load changes. In any case, the lower limit is a variable that depends on the machine loading. An overexcitation limit can also be provided for synchronous condenser applications where the maximum continuous load must be limited.

The synchronous-machine terminal voltage, as modified by the compensation and limit circuits, is supplied to the input Magamp where it is compared with the reference quantity. Any deviation of the terminal voltage from its normal regulated value causes a difference between the reference quantity and the voltage output of the compensation and limit circuits, which becomes an error signal. The error signal is amplified in the input Magamp and supplied to the power Magamp. The power Magamp includes two magnetic amplifiers—one biased to respond to a boost error signal and energize the boost control field, and the other biased to respond to a buck signal and energize the buck field.

The a-c supply for the reference unit and magnetic-amplifier circuits is an item of importance. The purpose of the regulating system is to control the terminal voltage of the synchronous machine, which is subject to minor variations due to load changes. During violent disturbances due to power-system faults, the synchronous-machine terminal voltage may be depressed to a low value.

To provide maximum reliability of the regulating system, the a-c supply is obtained from a permanent-magnet generator that is driven by an induction motor. Having no commutator, slip rings, or brushes, the permanent-magnet generator set is a rugged and reliable device that requires no regular inspection or maintenance. A flywheel provides sufficient inertia to carry the set through voltage disturbances on the a-c circuit that supplies the motor. The m-g set can be energized from the synchronous-machine terminals, the powerhouse auxiliary system, or any other acceptable source of power.

One design of reference unit, input Magamp, and compensation and limit circuits is used for all types and sizes of a-c machines. The ratings of the power Magamp and permanent-magnet m-g set are determined by the main exciter size and speed.

The rate of response or time delay of a magnetic amplifier is a function of the frequency of the a-c supply voltage. A higher supply frequency results in faster response and smaller magnetic-amplifier reactors. Therefore, having chosen an m-g set as the most reliable a-c supply, the frequency of the permanent-magnet generator was established at 420 cycles nominally. The result is a regulating system with very fast response and relatively small size. This higher frequency also simplifies stabilization of the regulating system because of the short time delays.

The components of the Magamp regulating system are assembled in a standard low-voltage metal-enclosed switchgear cubicle adjacent to the exciter field rheostat and field-breaker cubicles. The entire assembly is completely factory-adjusted and tested, and is shipped to the user ready for installation. Adjustment and routine checks at the time of installation require a minimum of time. The voltage-adjusting unit, regulator cutout switch, voltmeter, and indicating lamps are items required for control of the regulator and excitation system. These are located conveniently on the operator's control board. The reference unit, compensation and limit circuits, the input and power magnetic amplifiers are located in one cubicle; the main exciter motor-operated field rheostat is located in a second cubicle; and the main exciter breaker, and reserve exciter output breakers, if required, are mounted in a third cubicle.

High-Temperature Turbine

PRODUCTION of a turbine which will operate with the highest steam temperature ever used in a turbine-generator unit has been announced by the General Electric Company Turbine Division.

The new turbine, operating at an initial temperature of 1100

F, will be used in a turbine-generator unit for the Kearney generating station of the Public Service Electric and Gas Company of Newark, N. J. The 145,000-kw unit is the first of two for the New Jersey concern which will be placed in operation in the near future.

Primary objective of turbine design is constantly to improve turbine-generator efficiency so that electric companies can burn less fuel per kilowatt-hour of electricity. Higher steam temperature is one means of achieving this objective.

Previous highest temperature used in steam-turbine generators was 1050 F. The first machine using this temperature was a G-E unit installed at the Sewaren plant of Public Service Electric & Gas Company of New Jersey in 1948.

Among special design features of the Kearny machine is the use in the inner shells of stainless steel, which is necessary because of the high temperature.

This unit is one of the first 3600-rpm machines generating electricity at 20,000 volts. Another unique feature is that the boiler for the turbine will employ coal, oil, or gas, or a combination of all three as fuel. Steam will be used at a pressure of approximately 2350 psi.

Hydro Power Diminishing

ALTHOUGH it recommended early action on developing the hydroelectric resources of the St. Lawrence, Niagara, and Columbia Rivers, the President's Materials Policy Commission has foreseen a diminishing role for hydroelectric power and a correspondingly more important role for thermal power, according to *Public Power*, August, 1952.

The Commission has completed an 18-month survey of the nation's raw material and energy resources and in a chapter on electric power, the Commission declared that the central problem of electric energy is how to increase the nation's supply $2^1/_2$ times during the next 25 years without running into considerably higher costs per unit.

Except for coal, all of the sources of electricity, including hydro power, oil, and natural gas, are subject to pressures which could force their real costs up, the Commission noted. Although gas and oil undoubtedly will continue to be important fuels for thermal generation for many years, coal and lignite will probably become increasingly important for this use, the report said.

Addressing itself to the question of reducing the costs of thermal generation, the Commission said that the largest opportunities for cutting the costs of fuel transportation are provided by coal. Conveyer belts and pipe lines carrying a slurry of pulverized coal and water are being tested. Pit-head generation of electricity is being introduced more widely in major coal areas, and as transmission distances increase, the combination of pit-head thermal generation and highly efficient transmission could eventually reduce costs in areas along the Atlantic coast where distant fuel sources result in electric rates well above the national average.

The Commission acknowledged that opinions differ widely as to how much of the undeveloped hydroelectric power it would be economical to bring in before 1975. It is quite possible, the Commission noted, that our supply of hydroelectric energy could economically be doubled and conceivably be increased to 350 per cent of 1950 levels. (According to the FPC only 16 per cent of the nation's 105,000,000 kw of potential hydropower has been developed, with another 5 per cent under construction.)

Even with maximum increase, hydroelectric energy could scarcely supply one quarter of the nation's probable total needs for electricity by 1975—thermal generation will have to carry the main burden of further expansion, it was stated in the report.

In Volume II of its report, entitled "The Outlook for Key Commodities," the Commission noted that the trend of the aluminum industry away from dependence upon hydroelectric power can be expected to continue in the future. Aluminum producers, the Commission stated, will increasingly have alternative choices in the location of primary reduction capacity, depending upon their own particular cost situations.

Prior to World War II, the report pointed out, it was the practice to establish aluminum reduction plants at points where low-cost hydroelectric power was available. If this practice were to continue, most of the domestic expansion of reduction capacity during the next 25 years probably would occur in the Columbia River area, which is the only remaining domestic source of large low-cost hydroelectric potential, the Commission declared.

However, the sharp postwar decrease in the cost of steam-generated power, the higher cost of hydroelectric installations, and the higher total cost structure of the industry have combined to produce a substantial shift in the relative importance of the various cost factors, particularly power and transportation, the report stated.

When total production and marketing costs are taken into account, including the relationship of transportation costs to the location of bauxite, electric power, fabricating facilities, and markets, it appears that no significant increase in the real cost of producing and marketing aluminum would result from using power derived from well-located deposits of coal or lignite, compared to new hydroelectric power in the Pacific Northwest.

During the next 25 years, the report said, domestic primary aluminum capacity may expand in a number of areas, including the Pacific Northwest, the lignite regions of Texas, and the western Mountain States, and near the coal deposits of Tennessee and the Ohio Valley.

Harnessing Natural Steam

WHETHER or not natural steam can be harnessed to produce electricity is a problem being tackled by scientists and engineers in the North Island of New Zealand, according to an article by J. Grindrod, in *The Steam Engineer* for August, 1952.

The region around Rotorua has long been famous for its hot springs, geysers, and blowholes and has attracted visitors from all over the world; but it was not until after the second world war that the possibilities of putting this subterranean steam to economic use began to be considered, nor was it until a little more than 18 months ago that practical investigations were begun, Mr. Grindrod revealed.

New Zealand engineers and scientists first saw the scope there might be in making use of thermal energy (as at Larderello, in Italy, see "Natural Steam Power Plants of Larderello," by Giuseppe Donato, MECHANICAL ENGINEERING, September, 1951, pp 709–712) in the closing stages of the last war, and the progress of their present experiments at Wairakei seems to be justifying their beliefs. It is too early yet to speak of unqualified success, the article notes, but investigations have now reached a stage at which the harnessing of a pilot plant of 10,000 kw capacity is not expected to be long delayed. There are still snags and difficulties, but it is hoped that these will soon be overcome.

In the same region is the celebrated Karapiti blowhole, which emits hot dry steam, ideal for use in turbines. It was hoped that by sinking artificial boreholes similar efficient steam would be procured.

Altogether, 12 bores have been sunk thus far, the normal

depth being about 1100 ft. Of these, for instance, one 4-in. bore has been found to have a theoretical output in energy of 15,000 kw. All the bores have produced steam, and have continued to produce steam for as long as they were allowed, the one just mentioned for 4½ months, another for seven months. When blowing, the steam escapes with a shriek and a roar that can be heard four miles away.

But most of the artificial blowholes, thus far, have discharged steam, which, although well above boiling point has been heavily charged with water. This, of course, has the effect of reducing energy and, therefore, value, though it does not rule them out altogether. Two recent bores have given off the desired dry steam. One, drilled near a thermal flaw, runs fairly dry, and if shut off, will begin again completely dry.

Greater hopes, too, are being pinned to two new boreholes that are being sunk in the same valley, in which is situated the Karapiti natural blowhole, Mr. Grindrod revealed. One of the promising factors in these holes is that the drills are cutting through a covering layer of rhyolite rock, which is considered by the men on the job as being the best formation so far.

Drilling the various holes has been done by bits with six tungsten-carbide teeth. This is rotated by the rig, and, as it cuts through the hot wet pumice, the core is collected in 20-ft lengths of hollow steel rod. The circulating water, steaming hot, splashes the pumice mud in all directions. At a depth of 1000 ft or so the temperature is more than twice the boiling point of water, and, when after every 10 ft of drilling the rods are taken out to allow for examination of the core, the uncoupling of the joints, amidst a cloud of steam from the seething pumice mud, is no pleasant task. When the rod is thus taken up, a special covering for the hole prevents the upsurge of steam and mud.

A stage is now claimed to have been reached when work with a view to the direct exploitation of these blowholes can be begun. New equipment in the form of six new drills—two light drills, two capable of drilling down to 1500 ft, and two for large holes to depths of up to 2500 ft—have been ordered. When these are installed the work will be forged ahead, day and night.

How many thousands, or hundreds of thousands of kilowatts will ultimately be generated remains to be seen, but the New Zealand engineers are confident that they are working in the right direction. They believe that practical exploitation is only a matter of time—and not so long at that.

Steam-Turbine Alloy

A NEW alloy called "Cond-Al," developed by General Electric Company, has enabled the company to begin manufacture of steam-turbine-generators which are said to be 35 per cent more powerful than any of their type now in existence.

The outcome of eight years of research, Glenn B. Warren, Fellow ASME, general manager of the G-E Turbine Division, announced that Cond-Al is composed of aluminum, with very small quantities of iron, magnesium, and silicon.

The alloy's lightweight, high conductivity, and resistance to various stresses in high-speed, high-temperature operation remove a previous limitation on size of turbine generators.

Manufacture of the first four turbine-generators to use the new alloy is well under way with the first unit slated for completion this fall. Each of the units is rated at 216,000 kva, and will operate at 3600 rpm. The world's largest and most powerful turbine-generator of this type at the present time is a 160,000-kva machine built recently by General Electric for a midwestern utility.

Mr. Warren disclosed that orders have been received for many more 216,000-kva turbine-generators, and that units rated at higher than 300,000 kva are now being developed.

The new 216,000-kva units, when assembled, will each weigh more than 700 tons and will be nearly 82 ft long, 17 ft wide, and more than 10 ft high above floor level. Because of their size, the stator, or frame, of each of the units will be too large for shipment as a unit. A method of double-frame construction has been developed for the new type of turbine-generators, Mr. Warren said.

Earlier steam-turbine-generators developed by G-E operated at 1800 rpm, he said. With the growing need for increased efficiency and economy in power production, G-E, in the early 1900's, pioneered the design and development of machines operating at 3600 rpm, Mr. Warren declared. For the next 25 years, conventional copper field windings were satisfactory in the high-speed generators as well as the 1800-rpm models.

As the demand grew for larger turbine-generators, conventional field windings were found to have certain limitations when used in larger generator rotors revolving at high speed and under very high temperatures.

Exhaustive research was begun to solve the problem, and after many different alloys were tested, the Cond-Al formula was finally perfected.

Gas Injection

GREATLY increased oil recovery, and consequently a longer productive life, was gained partly as a result of using gas injection to stimulate oil production in a part of the Cabin Creek oil field in Kanawha and Boone Counties, W. Va., according to a recently released Bureau of Mines report.

Gas injection is a secondary-recovery method in which natural gas is pumped underground to force oil into producing wells. Its use in the Cabin Creek field is described in the Bureau's study. The report gives results of a study made by Bureau engineers with the co-operation of the Pure Oil Company's Eastern Producing Division.

The Cabin Creek field is in the south central part of West Virginia, and the area investigated was approximately 600 developed acres designated by the operator as project 4. The oil reservoir is in Berea sandstone at depths ranging from 2914 to 3410 ft. The project was developed from 1917 to 1924, and gas injection was begun in 1935.

Gas injection was successful, and according to the report, if it had been continued it could have increased ultimate oil recovery in project 4 by an estimated 1,660,000 bbl and extended the productive life of the project some 20 years. However, without gas injection or some other secondary-recovery method such as water flooding, the area would have reached an economic limit by 1950 with a cumulative production of only 3,990,000 bbl, as compared with 5,650,000 bbl which Bureau engineers estimate would have been produced by 1970 using the gas-injection methods.

It was estimated that even with the successful gas-injection project, ultimate recovery would amount only to 25.6 per cent of the original oil in place. The report concludes that the relatively high oil saturation and low water saturation in the reservoir at the present time are satisfactory for a successful water-flood project. Conversion to water flooding was started recently in the project.

A free copy of Report of Investigations 4899, "Petroleum-Engineering Study of Gas-Injection in the Cabin Creek Field, Kanawha and Boone Counties, W. Va.," may be obtained from the Bureau of Mines, Publications Distribution Section, Pittsburg 13, Pa.

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

THIS month's "Digest" section is devoted entirely to papers presented at the 1952 ASME Fall Meeting which was held in conjunction with the Centennial of Engineering. A general account of the Centennial sessions, symposiums, and the numerous functions that took place during this 100-years-of-engineering celebration appears on pages 867-876 of this issue. The story of the 1952 ASME Fall Meeting, summarizing the numerous events scheduled, is contained in the "News Section of this issue."

Production Engineering

Vibrations in Knee-Type Horizontal Milling Machines, by Ivar Bendixen, The Machine Tool Laboratory, Technical University, Ostervoldgade 10, Copenhagen K, Denmark. 1952 ASME Fall Meeting paper No. 52—F-42 (mimeographed; to be published in Trans. ASME).

THIS paper outlines a series of tests on vibrations in knee-type horizontal milling machines, especially in the knee system. The amplitude of the vibrations was determined by means of a capacitive pickup. Systematic investigations on the importance of clamping and unclamping the various elements are made.

The influence of damping in the case of resonance is pointed out. An explanation of the vibration accompanying entrance and exit of the milling cutter is indicated. A theory for the presence of low natural frequencies in the knee system is developed. Up and down milling are compared.

Some Observations on Chip Curl in the Metal-Cutting Process Under Orthogonal Cutting Conditions, by R. S. Hahn, Mem. ASME, The Heald Machine Company, Worcester, Mass. 1952 ASME Fall Meeting paper No. 52—F-16 (in type; to be published in Trans. ASME).

IT IS well known that chips, arising in the metal-cutting process with single-pointed tools, often exhibit a tendency to curl. To date there appears to be no satisfactory explanation of this phenomenon. Although the curling of chips as such is of little concern to those in the machine shop, except perhaps when it is desired to break the chip, this effect, when understood, may help in the theory of machining. The curvature of the chip is an additional quantity which may be measured and, when its meaning is understood, will provide a deeper insight into the metal-cutting process.

In this experimental study of the phenomenon of chip curl, it was found that transient behavior of the chip curvature was independent of cutting speed. Evidence is offered to show that chip curl originates in the shear region. Numerous hypotheses were made to explain the curl and were examined. It appears that the chip curl is associated with thermal effects in the shear region.

Deformation Work Absorbed by the Workpiece During Metal Cutting, by E. G. Thomsen, J. T. Lapsley, Jr., and R. C. Grassi, Mem. ASME, University of California, Berkeley, Calif. 1952 ASME Fall Meeting paper No. 52—F-24 (mimeographed; to be published in Trans. ASME).

IN METAL cutting the waste metal is removed from the workpiece in the form of chips. In the process both the chip and the top layer of the work surface are plastically deformed, the severity of deformation depending on the cutting condition. In the analysis of metal-cutting data, however, the workpiece deformation is usually ignored and all deformation work is considered as going into the chip. The question to be answered then is—how much is this work of deformation of the workpiece and will appreciable error result in analyzing metal-cutting data if all energy of cutting expended is charged to the chip?

This deformation work absorbed by the workpiece during metal cutting is analyzed. It is shown from photomicrographs that this is appreciable and may constitute the major energy absorbed in metal cutting when the depth of cut becomes small. The so-called "Size Effect in Metal Cutting" may in part be explained by this workpiece deformation. Correcting cutting forces for workpiece deformation in no way detracts from Merchant's analysis, based on the mini-

How to Order ASME Papers

PAMPHLET copies of ASME papers referred to in this section are available, until the supply is exhausted, at 25 cents each to members; at 50 cents each to nonmembers. ASME papers published in full or condensed form in other sections of MECHANICAL ENGINEERING are not included in this Digest Section.

To facilitate ordering papers, coupon books, each containing ten coupons, are available to members at $2 each, to nonmembers at $4 each. These coupons may be used to purchase papers presented at ASME Meetings.

When not using coupons, remittance must accompany all orders of $5 or less.

When ordering, please give number assigned to article, title, author's name, and number of copies wanted. Orders should be sent to the ASME Order Department, 29 W. 39th St., New York 18, N. Y.; or use convenient order form below.

NOTE: ASME Publications and advance copies of ASME papers are on file in the Engineering Societies Library and are indexed by the Engineering Index, Inc., both at 29 W. 39th St., New York, N. Y. ASME Transactions and *Journal of Applied Mechanics* are also on file in ASME depositories maintained in 245 libraries in the United States, including libraries of all ASME Student Branch institutions.

ASME Order Department
29 W. 39th St., New York 18, N. Y.

Date.....

Please send me the papers indicated by the following circled numbers:

52—F-9	52—F-22	52—F-36
52—F-10	52—F-23	52—F-37
52—F-11	52—F-24	52—F-38
52—F-12	52—F-25	52—F-39
52—F-13	52—F-26	52—F-41
52—F-14	52—F-27	52—F-42
52—F-15	52—F-28	52—F-44
52—F-16	52—F-29	52—F-46
52—F-17	52—F-30	52—F-47
52—F-18	52—F-31	52—F-48
52—F-19	52—F-33	52—F-49
52—F-20	52—F-34	52—F-50
52—F-21	52—F-35	52—F-51

Name.....

Address.....

☐ Remittance enclosed ☐ Bill me
☐ ASME Mem. ☐ Nonmem.

mum-energy principle. However, the criteria of plasticity in metal cutting and the correlation of metal-cutting data with tensile data remain in doubt.

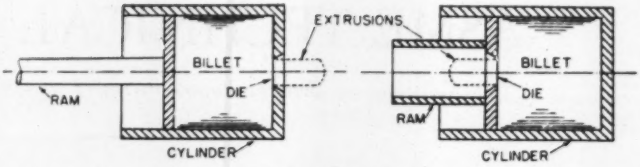
Plastic Flow in a Lead Extrusion, by C. T. Yang, Massachusetts Institute of Technology, Cambridge, Mass., and E. G. Thomsen, University of California, Berkeley, Calif. 1952 ASME Fall Meeting paper No. 52—F-18 (mimeographed; to be published in Trans. ASME).

COMMERCIALLY pure lead was extruded through a sharp-edged circular orifice by an indirect or inverted extrusion process. Metal-flow directions and plastic strains were determined during a small stepwise deformation process from distorted, originally square, grid-line network scribed on a meridian plane.

It was found that the metal-flow directions do not coincide with instantaneous grid-line directions nor with the streamline directions in frictionless or potential fluid flow. It was further found that the metal located in the corner, formed by cylinder wall and die face, was in a state of plastic deformation.

This observation is contrary to previously reported investigations and shows that the surface quality of the finished extrusion is dependent on the surface quality of the billet from which the extrusion was pressed.

A strain analysis was made from which principal stress directions in the plastic metal were calculated.



SCHEMATIC DIAGRAM OF EXTRUSION PROCESSES

[(*a*) Direct extrusion: Ram and extruded part move in the same direction. (*b*) Indirect extrusion: Ram and extruded part move in opposite direction.]

Rubber and Plastics

Mechanical Properties of Glass-Cloth Plastic Laminates as Related to Direction of Stress and Construction of Laminate, by F. Werren, Forest Products Laboratory, Madison, Wis. 1952 ASME Fall Meeting paper No. 52—F-36 (mimeographed; to be published in Trans. ASME).

IN STUDIES of the mechanical properties of wood, the Forest Products Laboratory has developed mathematical theory concerning these properties on the basis that wood is an orthotropic material—that is, a material having three mutually perpendicular planes of elastic symmetry. Under certain conditions, plywood can also be considered to be orthotropic, as are paper and paper laminates. Reinforced plastic laminates, made of sheets of woven fabric and resin, are also generally orthotropic, as are most of the core materials used in the construction of sandwich material for aircraft.

The development, verification, and application of the mathematical theory were accelerated during World War II, particularly as applied to plywood for use in aircraft. Much of this information was obtained in co-operation with the Army-Navy-Civil Committee on Aircraft Design Criteria and has subsequently been published as an ANC bulletin.

Since the mathematical treatment for wood and plywood, which has been verified by tests on these materials, is general in nature, it should be applicable also to other orthotropic materials, such as glass-cloth laminates. This paper presents applicable equations and relates them to tests of glass-cloth plastic laminates for (1) the directional properties in tension, compression, and shear when no buckling occurs, and (2) the mechanical properties of composite or cross-laminated, glass-cloth, plastic laminates. Acceptable equations for calculating these properties are given.

Effect of Preloading and Fatigue on Mechanical Properties of Glass-Cloth Plastic Laminates, by A. D. Freas, Forest Products Laboratory, Madison, Wis. 1952 ASME Fall Meeting paper No. 52—F-35 (mimeographed; to be published in Trans. ASME).

MOST glass-cloth plastic laminates, when loaded in tension, produce a load-deformation curve that exhibits two straight lines, which differ somewhat in slope. A question arises, therefore, as to the significance of the initial and secondary values of modulus of elasticity and stress at proportional limit and as to the effect on these values of loading to a stress below the secondary proportional limit. An aircraft structural part in service will be frequently loaded to a stress beyond the initial stress at proportional limit, and any effect of such preloading on the reported properties of a laminate would be of practical significance to the aircraft designer.

Preloading once or a few times to some stress level may be expected to affect such properties as modulus of elasticity and stress at proportional limit without necessarily having a significant effect on the ultimate strength. Frequently repeated or reversed loadings above certain minimum stress levels, however, are known to reduce the breaking strength below that which is measured in a static test.

Fatigue tests may be likened to preload tests, except that the preload tests reported herein are limited to a few preloads (generally only one), while the fatigue-test "preloads" are numbered in the thousands or millions. During their service lives, most aircraft structures are subjected to many repetitions or reversals of load. Some knowledge of the load level that may be repeatedly sustained without failure is therefore necessary to the intelligent design of aircraft structures.

This report presents the results of fatigue and preload tests to serve as a guide to the fatigue behavior of glass-fabric laminates.

The tests showed that modulus of elasticity and proportional-limit stress may be changed considerably after the first application of stress. A small number of preloads, in either tension or compression, have no appreciable effect on the strength of the laminate. The application of many repeated or reversed stresses, however, may result in a fatigue strength that is much lower than the static strength of the material.

Heat Transfer

Influence of Unheated Starting Sections on the Heat Transfer From a Cylinder to Gas Streams Parallel to the Axis, by William Tessin, Jun. ASME, Commander, U. S. Navy, and Max Jacob, Mem. ASME, Illinois Institute of Technology, Chicago, Ill. 1952 ASME Fall Meeting paper No. 52—F-21 (mimeographed).

THE present investigation, sponsored by the U. S. Naval Postgraduate School, and performed in Illinois Institute of Technology, is an extension of the work of Jakob and Dow dealing with the heat transfer between a cylinder and air flowing parallel to the longitudinal axis.

Spherically tipped nosepieces of vari-

ous lengths were attached to an electrically heated cylinder. The results show that the heat transfer is independent of the actual lengths of nosepieces but is a function of the ratio of heated length to total length. Comparison of the results with those of Jakob and Dow indicates a decrease of the heat transfer with increasing cylinder radius. Extrapolation to infinite radius (flat plate), however, is uncertain. Therefore it is recommended to use an average value of the heat-transfer coefficient independent of the curvature, pending further studies of the influence of configuration and turbulence level.

The Determination of Local Forced-Convection Coefficients for Spheres, by John R. Carey, Douglas Aircraft Company, Long Beach, Calif. 1952 ASME Fall Meeting paper No. 52—F-29 (mimeographed).

IN THE course of the design of an airplane component consisting of a large hemispherical shell required to be maintained free of ice, a survey of the literature revealed no data for predicting the local rate of heat dissipation from a spherical surface exposed to the cooling influence of a surrounding medium moving relative to the sphere.

The local heat-transfer coefficient on the surface of a sphere was therefore investigated in the range of Reynolds numbers from 44,000 to 151,000. Correlation of experimental data is based on the Nusselt and Reynolds numbers, and two curves are presented for the relation between the Nusselt and Reynolds numbers as a function of the angle from the stagnation point.

Although the study was carried out on a sphere, it is anticipated that the data obtained may be applied as first approximations to local coefficients on geometrically similar bodies such as paraboloids, ellipsoids, and other surfaces of revolution until such time as data for these particular surfaces may be gathered.

An Investigation of Heat Transfer From an Inclined Flat Plate in Free Convection, by Ben R. Rich, Lockheed Aircraft Corporation, Burbank, Calif. 1952 ASME Fall Meeting paper No. 52—F-20 (mimeographed).

THE differential equations for heat transfer from vertical plates in free convection were rederived in dimensionless form and extended to include inclined plates. The analysis indicated that the only change in the plate was the component of the gravitational force in the plate surface direction. The limitation of the equation is that the flow be laminar and two-dimensional.

Heat transfer from a flat plate in free convection was studied at angles of inclination ranging from 0 deg to 40 deg measured from the vertical, for a range of Grashof numbers from 10^8 to 10^9 and temperature differences from the surface to the surroundings of 200 to 260 F.

The investigation shows the inclined-plate nondimensional unit thermal conductance, Nu, can be predicted from vertical-plate conductances. The Grashof number in the Nusselt relation for the vertical plate, when modified by the cosine of the angle of inclination, can predict the inclined-plate conductances to within 10 per cent of those determined experimentally.

Direct Graphical Evaluation of Radiation Form Factor, by F. C. Hooper and I. S. Juhasz, University of Toronto, Toronto, Can. 1952 ASME Fall Meeting paper No. 52—F-19 (mimeographed).

IN THE analysis of problems involving radiant heat exchange between finite surfaces, the concept of a geometrical or form factor is introduced to represent the special relationship of the surfaces. Although the concept is simple, the mathematical evaluation of this factor is very much involved, even in quite elementary problems.

In more complex problems direct mathematical solutions are impossibly difficult. As a consequence of this difficulty, approximate solutions are usually obtained by similitude to elementary surface relationships which have been evaluated mathematically or by the use of models, and for which tabulated solutions are available in the literature.

This paper presents a graphical method for the direct evaluation of the form factor, requiring only the horizontal and vertical orthogonal projections of the surfaces in question to be known.

Machine Design

Critical Whirling Speeds of Shaft-Disk Systems, by N. H. Jasper, Jun. ASME, David Taylor Model Basin, U. S. Navy Department, Washington, D. C. 1952 ASME Fall Meeting paper No. 52—F-33 (mimeographed).

THIS paper discusses the effects of rotary inertia, gyroscopic precession, and bearing flexibility on the lower modes corresponding to the natural flexural and whirling frequencies of shaft-disk systems for all spin-to-whirl ratios. The mass of the shaft is considered negligible in relation to the disks. A simple formula for a single-disk system is developed which permits arbitrary bearing arrangements, but which requires that the stiffness of the bearing support is uniform in all directions. Next, the method is extended to include nonuniform bearing flexibility. The method is extended still further to indicate the solution for a system of many disks with arbitrary bearing supports and any number of spans.

As an illustrative example, the method is applied to the case of a ship's shaft propeller system and the theoretical and experimentally derived values are compared.

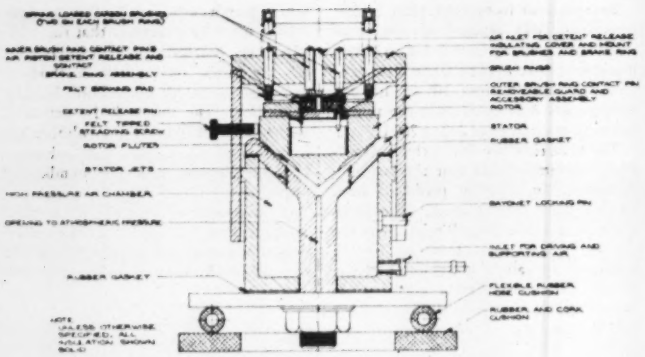
On the Solution of the Reynolds Equation for Slider-Bearing Lubrication—III Effect of Transverse Curvature, by A. Charnes, E. Saibel, Mem. ASME, and A. Ying, Carnegie Institute of Technology, Pittsburgh, Pa. 1952 ASME Fall Meeting paper No. 52—F-37 (mimeographed; to be published in Trans. ASME).

THE problem of slider-bearing lubrication with side leakage for film thickness varying exponentially in the direction of motion has been considered in a previous paper. The film thickness has, however, been taken as constant in the transverse direction (perpendicular to motion). Little information seems to be available on the slider-bearing problem with film thickness varying in both directions, although this is of great importance especially for small curved film thickness in the transverse direction.

In this paper, the slight variation of film thickness in the transverse direction is taken care of by a perturbation of the solution obtained in the previous paper. Due to the simplicity of the previous solution, the present result turns out to be quite tractable and is valid for any ratio of length to width of slider, or for any ratio of entrance to exit clearances or for any ratio of center to side clearances.

A Simple High-Speed Air Spinner for Centrifugal Testing of Small Mechanical Devices, by C. F. Bild and P. F. Vial, U. S. Naval Ordnance Laboratory, Sandia Corporation, Albuquerque, N. Mex. 1952 ASME Fall Meeting paper No. 52—F-34 (mimeographed; to be published in Trans. ASME).

THIS project was started with the purpose of developing a simple laboratory spinner for checking time intervals of small timing devices at spins up to 36,000 rpm and for checking strength and operation of small devices at spins up to 120,000 rpm. It was also desired that this new spinner eliminate or minimize the bearing wear, balancing problems,



SECTIONAL VIEW OF AIR SPINNER

and heating problems inherent in other types of spinners.

It was found that:

1 The spinning-top type of air spinner is ideally suited to high-spin developmental laboratory testing.

2 Clock-type mechanisms have been timed at spins of 36,000 rpm (600 rps) in rotors of $3^1/_4$ in. diam.

3 If considerably higher spins than 36,000 rpm are needed, they can be obtained by one or more of the following: Increasing air pressure, decreasing brush pressure, streamlining the rotor shape, polishing the rotor body, or decreasing rotor diameter. For example, a $2^1/_2$-in-diam rotor, using 100 psi air pressure has been built and spins up to 66,000 rpm. Also, a rotor of $1^1/_4$ in. diam can be made to reach approximately 120,000 rpm with 100 psi air pressure.

4 The chief advantages of this type of spinner are simplicity and economy of construction, versatility, relative insensitiveness to static unbalance, quietness, no heating problem, no bearing wear, and a minimum of maintenance.

A Method of Obtaining Shear Stress-Strain Graphs by Interpretation of Moment-Twist Data, by Paul H. Kaar, U. S. Bureau of Mines, Schuylkill Haven, Pa. 1952 ASME Fall Meeting paper No. 52—F-31 (mimeographed; to be published in Trans. ASME).

MANY requests are made by industry for information from the Fritz Engineering Laboratory at Lehigh University. Among these was one from a manufacturer wishing to increase the strength of his industrial-truck axles. The manufacturer was considering several different steels and wanted comparative-strength data. The information was compiled by use of shear stress-strain curves.

The method described to obtain the shear stress-strain curves is not new, but is not often used. The procedure is simple to apply and merits the attention of others concerned with comparative strength and shear properties of axial round shafts.

Applied Mechanics

The Analysis of Fully Restrained Slabs Under Concentrated Loads, by C. A. M. Gray, University of Sydney, Sydney, N. S. W., Australia. 1952 ASME Fall Meeting paper No. 52—F-13 (in type; to be published in the *Journal of Applied Mechanics*).

THE analysis of fully restrained, thin, elastic slabs under concentrated loads is usually made by adding suitable edge moments to the simply supported solution. In this paper use is made of Muschelisvili's solution, of the biharmonic equation. From it we determine two analytic functions $\Omega(z)$ and $\omega(z)$ of the complex variable z, given, for simply connected areas, by two integral equations of which a direct solution is possible, provided that the boundary conditions are in a suitable form, and the transformation of the loaded area to a unit circle is known. For fully restrained slabs under concentrated loads, provided the singularities introduced at the loading points are removed, the boundary conditions are of a suitable form for a direct application of Muschelisvili's equations. In this paper the load-point singularities are removed by taking the solution for a fully restrained circular slab inscribed in the given area and similarly loaded. Two illustrations of the method are given: an infinitely long rectangle loaded at the center, and a square slab loaded at the center. In both cases the solution is obtained for the edge moments without an excessive amount of labor.

Symmetric Turbulent Mixing of Two Parallel Streams, by T. P. Torda, W. O. Ackermann, and H. R. Burnett, Department of Aeronautical Engineering, University of Illinois, Urbana, Ill. 1952 ASME Fall Meeting paper No. 52—F-14 (in type; to be published in the *Journal of Applied Mechanics*).

THE analysis of turbulent, incompressible, symmetric mixing of two parallel streams is presented. The influence of the upstream boundary layers on the mixing process is taken into account. The von Kármán integral concept is applied to a momentum and energy equation. These equations are used to evaluate the thickness of the mixing region and the velocity distribution in it. The results are presented in nondimensional form. A numerical illustrative example is given. Comparison with Tollmien's analytical results and with experimental data of Liepmann and Laufer is made.

The New Approach to Shell Theory: Circular Cylinders, E. H. Kennard, David Taylor Model Basin, Washington, D. C. 1952 ASME Fall Meeting paper No. 52—F-9 (in type; to be published in the *Journal of Applied Mechanics*).

TAKING Epstein's basic work on elastic vibrations in plates and shells, the author proceeds to construct expressions for the distributions of stress and displacements. From these, stress resultants are calculated. The principal effects of external load on the faces of the shell are included, and the validity of the approximation and practical applications of results are discussed.

A Nondestructive Differential-Pressure Test for Thin Shells, by J. C. New, Naval Ordnance Laboratory, Silver Spring, Md. 1952 ASME Fall Meeting paper No. 52—F-10 (in type; to be published in the *Journal of Applied Mechanics*).

THE differential-pressure test is an original, nondestructive, experimental technique for determining incipient buckling pressures of thin shells subjected to external pressure. Extensions of the basic test permit study of many buckling parameters as well as other mechanical factors in thin-shell design and evaluation. The salient feature of the technique is the

filling of the internal volume of the shell with a compressible fluid, such as water, to control the magnitude and rate of shell deformation. The incipient buckling pressure is detected by noting the point at which the difference in internal and external pressure becomes constant. Experimental verification of the technique and its nondestructive aspect is presented. Applications and limitations of the test are discussed.

The Forced Oscillation of the Centrifugal Pendulum With Wide Angles, by F. R. E. Crossley, Mem. ASME, Yale University, New Haven, Conn. 1952 ASME Fall Meeting paper No. 52—F-11 (in type; to be published in the *Journal of Applied Mechanics*).

THE simple pendulum mounted to a rotor suffering torsional oscillation is used as an effective dynamic damper which may be tuned to any one harmonic order of vibration. The nonlinear equations of motion are here developed to investigate whether wider angles of swing or whether larger or smaller sizes of pendulum relative to its carrier, are more effective. Resonance-type curves are drawn by assuming a single harmonic excitation and hyperelliptic pendulum motion without damping; it is shown that theoretically oscillations up to 90 deg may be used which are predictable, and that in all cases the tuning must be higher than that indicated by small-angle theory.

Numerical Analysis of Forced Vibrations of Beams, by N. O. Myklestad, Mem. ASME, University of Illinois, Urbana, Ill. 1952 ASME Fall Meeting paper No. 52—F-12 (in type; to be published in the *Journal of Applied Mechanics*).

IN THIS paper a simple tabular method is developed by which the vibration amplitudes, bending moments, and shear forces of a beam of variable but symmetrical cross section, carrying any number of concentrated masses and acted on by any number of harmonically varying forces can be found. The driving forces must all have the same frequency but the phase angles may be different. The method is an extension of the one employed by the author to find natural modes of vibration of beams, but in the case of forced vibration only one application of the tabular calculations is necessary, making it essentially a far simpler problem than that of finding the natural modes. Internal damping of the beam material is easily considered and should always be taken into account if there is any danger that the forced frequency is near any one of the natural frequencies.

On Asymmetric Flow in an Axial-Flow Compressor Stage, by W. R. Sears, Cornell University, Ithaca, N. Y. 1952 ASME Fall Meeting paper No. 52—F-15 (in type; to be published in the *Journal of Applied Mechanics*).

IT IS suggested that flow patterns without axial symmetry may occur when an axial-compressor stage operates in a steady, uniform stream, provided that the blade airfoil characteristics exhibit certain peculiarities. For example, blades acting close to the stall may show nonlinearity, hysteresis, and/or time lags, and these may cause asymmetric flow patterns. Conditions necessary for existence of such phenomena are analyzed by consideration of an annulus of infinitely many blades and very large radius. It is shown that rotational-flow effects due to vortex shedding by the blades must be considered. The induced velocities resulting from asymmetrical loadings are calculated. The final step of the calculation is to show that these induced effects may actually support the circulation distribution that produces them. This step is only partly taken in the present paper. It is shown that time lag in the development of lift of a blade may produce such "eigen-solutions." Detailed study of the results of nonlinearity in the blade characteristics is left for another investigation.

Gas-Turbine Power

The Development of Gas-Turbine Controls, by G. Forrest Drake, Woodward Governor Company, Rockford, Ill. 1952 ASME Fall Meeting paper No. 52—F-23 (mimeographed).

THIS paper gives a brief historical outline of the activities of one organization, the Woodward Governor Company, in the field of gas-turbine controls development, primarily those controls intended for aircraft-propulsion turbines.

In addition to the complete turbojet control the company has designed and supplied speed governors for incorporation in the controls of others. One of these is an isochronous governor. Such a unit can serve either as a primary speed control or as a speed-limiting or topping governor and has been used both ways.

The units discussed in this paper have been intended for the larger aircraft-propulsion turbojet engines. Parallel development work has been carried on to provide controls for the smaller gas turbines intended, in their turbojet form, for guided-missile or target drone propulsion or, when provided with a power output shaft, for auxiliary power units or other applications in which they compete with conventional reciprocating engines.

The Application of Temperature Control to Turbojet Engines, by J. F. Engelberger and H. W. Kretsch, Manning, Maxwell & Moore, Stratford Conn. 1952 ASME Fall Meeting paper No. 52—F-38 (mimeographed).

TEMPERATURE control for the turbojet engine has become of basic importance as the result of introducing such parameters as a variable exhaust-nozzle area and afterburning.

The requirements for such a control are considered in detail from the points of view of temperature measurement and of control response characteristics necessary to adequately protect the turbine blades.

An example of a temperature control modulating the exhaust-nozzle area is analyzed and the transient response of the control in an actual installation is presented.

It is concluded that measurement accuracy constitutes a greater problem than loop transient performance.

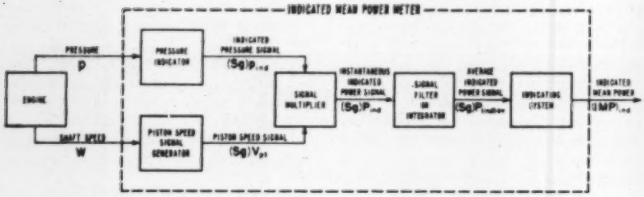
Instruments

Design of a Square-Root-Extracting, Force Balance, Pneumatic Transmitter Including Derivation of Formulas, by Arnold Goldberg, Goldberg Engineering Company, Chicago, Ill. 1952 ASME Fall Meeting paper No. 52—F-41 (mimeographed; to be published in Trans. ASME).

A COMMON method of measuring the flow of a fluid in a pipe is to place an obstruction in the pipe, such as an orifice. A pressure difference will develop across the orifice, and by measuring this pressure difference one can determine the flow rate. The relation between the rate of flow of the fluid and the differential pressure associated with it is assumed to be $Q = k\sqrt{2g\Delta P}$

This assumption holds true over a wide range of Reynolds numbers provided that conditions permit neglecting the expansion of the fluid as it passes through the orifice.

Note that the flow rate is proportional to the square root of the differential pressure. An instrument graduated in flow units would, therefore, have a "square-root" scale if no means were provided to alter it. Usually, a linear scale is desired and so it is necessary to



ESSENTIAL FUNCTIONAL DIAGRAM OF INDICATED-MEAN-POWER METER

extract the square root of the differential pressure. Also, a linear output is often necessary for use with automatic controllers.

This paper describes an instrument which accomplishes such a purpose. It deals with a particular type of flowmeter, one that measures the differential pressure developed across an orifice or other primary element and puts out an air pressure directly proportional to flow rate. The square-root-extracting part of the device is of the shaped displacer and mercury type, in which the displacer does not move. Formulas are derived for calculating the shape.

Direct-Reading Indicated Power Meter, by Y. T. Li, Massachusetts Institute of Technology, Cambridge, Mass. 1952 ASME Fall Meeting paper No. 52—F-17 (mimeographed).

AN INDICATED power meter which reads the product of imep and engine speed has been developed. The determination of the indicated power for each cylinder of an engine is useful in distributing equally the power output of the engine among the various cylinders, thereby improving efficiency and reducing maintenance difficulties.

The indicated power meter consists of an electromagnetic piston-speed-signal generator, a strain-gage pressure receiver, a suitable multiplying means, and an indicating system. The product of the piston-speed signal and the pressure signal yields the indicated-power signal. A field calibration method utilizing a synthesized-pressure signal is described.

The performance of the indicated-power meter in actual engine operation as compared with that obtained by graphical reduction of pressure data taken from a balanced pressure indicator showed good agreement under various engine conditions.

Steam Power Generation

Steel-Works Power Plants, by Robert W. Worley, Mem. ASME, and Harold J. Bentson, Mem. ASME, United Engineers & Constructors, Inc., Philadelphia, Pa. 1952 ASME Fall Meeting paper No. 52—F-46 (mimeographed).

THE waste or by-product fuels available in steel works constitute the principal reason for the existence of large power plants.

There is sufficient potential heat energy in these waste fuels to generate all power and steam requirements after satisfying every other practical use. Blast-furnace gas, the principal by-product fuel, presents combustion and boiler-design problems that are somewhat different from those met with in the more common and richer fuels.

Most of the installations being made today are in old plants and present difficulties of space limitation and fitting into existing steam and electric power systems. Six installations and methods of meeting difficult conditions are described.

Optimum Design for Surface Condensers for Steam-Power Plants, by James T. Fong, Burns and Roe Inc., New York, N. Y. 1952 ASME Fall Meeting paper No. 52—F-39 (mimeographed).

IN SELECTING surface condensers for steam power plants, the consulting engineers have to specify to the manufacturers most of the design variables governing the sizing of the condenser.

Often the choosing of the design variables is based on the engineers' experience or dictated by physical, metallurgical, and structural requirements, but it is possible to derive mathematical relationships between the variables so that the total annual fixed charges and the total cost chargeable to the circulating-water system including pumping charges is at a minimum. It is found that in most cases with the unit costs proposed, the value of the optimum circulating-water design velocity is somewhat higher than that specified in the industry today indicating that the present trend of limiting the design water velocity to about 7 to 8 fps maximum is primarily due to considerations of tube erosion. The general chart developed shows a decreasing value of optimum water velocity as the tube length of the condenser decreases. A general equation is also derived and a graphical solution developed for the optimum tube length of the condenser.

Emphasis is then laid on the proper choice of circulating-water inlet temperature and condenser vacuum as the design value.

The performance of any condenser may be represented by a general equation so that its effect on turbine exhaust pressure at different loads may be evaluated in terms of decreasing or increasing plant output. All these considerations enter into the optimization of surface condensers for steam power plants.

The Outdoor Power Station in South Texas, by Harry C. Hiebeler, Mem. ASME, Houston Lighting & Power Company, Houston, Texas. 1952 ASME Fall Meeting paper No. 52—F-50 (mimeographed).

THIS paper reports and discusses the operating and maintenance problems that have been encountered in three years of operation of the two Westinghouse 60/66 mw preferred standard machines at Greens Bayou and in two years of operation of the two General Electric 60/75 mw handbook units at West Junction, with some brief mention of pertinent previous experience on semi-outdoor jobs. Both plants are of straight-line (single-boiler single-turbine) arrangement with Riley steam generators fired by natural gas with oil stand-by. Throttle conditions are 850 psig, 900 F. The design features of the Greens Bayou Station have been described in an article by Louis Elliott in the December, 1949, issue of *Electric Light and Power*.

Greens Bayou Station is presently being extended by the addition of two 80/100 mw units and a new two 80/100 mw unit station is being built at the Webster site. Both will be of completely outdoor design. For a contemplated 100/125 mw addition at Deepwater, the boiler will be outdoors but the turbine room will be of conventional indoor arrangement.

When this expansion program is completed in 1955, total system capacity will approximate 1150 mw of which 8 units, or over 700 mw, will be of completely outdoor design. The outdoor boiler capacity will approach one million kw.

Operating Experiences With 1250 Gpm Demineralizer Water-Treatment Plant, by Daniel N. Purcell, Schuylkill Station, and Vincent B. Burgess, Philadelphia Electric Company, Philadelphia, Pa. 1952 ASME Fall Meeting paper No. 52—F-47 (mimeographed).

THIS paper describes the 1250 gpm demineralizing equipment at Schuylkill Station and also the operation and performance during the first 18 months' operation.

The equipment has consistently produced water containing less than 2 ppm mineral solids and silica removal to 0.02 ppm. However, after approximately 6 months' operation it was apparent that the cation units were falling off in capacity, although quality was still maintained. Some of the procedures that were applied in efforts aimed at a solution for the loss in capacity are described. Also observations and corrective measures are given in connection with the application of a 50 per cent make-up of demineralized water to two 600,000-lb per hr boilers operating at 1250 psi and 900 F total steam temperature.

The need for a demineralizer at the Schuylkill Generating Station of the Philadelphia Electric Company was brought about by the economic advantage of bleeding large quantities of steam from the 225 psi, exhaust header of the 50,000-kw topper turbine, to be delivered into the commerical steam-heat distribution system. The quantity of steam to be delivered into the commercial steam-heat distribution system imposed a 50 per cent, or 600,000-lb per hr make-up to the two 600,000-lb per hr, 1250 psi, boilers.

The demineralizing plant has in all cases given even better-quality water than design specifications. In this particular installation, this method of water treatment is the most feasible and economical.

Although some drop was noted in cation exchange capacity due to suspended material during the 18 months of operation, it is felt that the remedy has been found to restore full capacity to these exchangers.

The other difficulties which have been encountered and solved have been more in the nature of growing pains which are found in operating new equipment. Graver Water Conditioning Company has been especially helpful and co-operative in determining the solutions to the difficulties that have been encountered.

The Philadelphia Electric Company to date has been satisfied with the quality of water delivered by this method, while supplying sufficient quantity for the make-up due to the steam-heat output.

Fuels

Influence of Low-Quality Coal on Design and Operation of Pulverized-Coal-Fired Units, by Otto de Lorenzi, Fellow ASME, Combustion Engineering-Superheater, Inc., New York, N. Y. 1952 ASME Fall Meeting paper No. 52—F-48 (mimeographed).

COAL quality is governed, to a large extent, by sulphur and ash content, as well as ash-softening temperature. There is, however, no well-defined line separating so-called low-quality coal from high-quality coal. The type of equipment as well as character of plant load may frequently be responsible, in a large measure, for the category into which a given coal falls.

Principal characteristic features of modern pulverized-fuel-fired units have been developed through a process of evolution, based on a wide variation in fuel quality and on many different installations. Thus, after an evaluation of plant operating conditions, the designer must choose a combination of features which will assure satisfactory and trouble-free operation with the lowest-quality coal which it may be necessary to burn at some future date.

Discussion in this paper is limited to large high-pressure units such as are usually found in the more modern power generating stations. The fuels are bituminous coal, in which the sulphur contents range between 2.50 and 4.60 per cent, ash from 9.30 to 17.40 per cent, and ash-softening temperature from 1900 F to 2150 F.

One of the principal requirements of a modern unit is continuity of in-service operation over a long period of time at or somewhat above rated capacity. Shutdowns for routine insurance inspections and necessary maintenance work are frequently scheduled, for periods of from 2 to 14 days, once every 12 months. In a number of instances steam generators have been kept in service for as long as 19 months between outages for major maintenance work. To be capable of such high use factors, it is essential that a unit meet several exacting requirements.

Boiler Controls for Multiple Fuel Firing in Modern Steam-Generator Installations, by Alfred C. Wenzel, Mem. ASME, Republic Flow Meters Company, Chicago, Ill. 1952 ASME Fall Meeting paper No. 52—F-49 (mimeographed).

THIS paper discusses the basic factors which govern the design and selection of boiler-control equipment for multiple fuel firing in modern steam-generator installations, and gives a description of nine arrangements of controls for specific combinations of fuels and fuel-burning equipment.

It is found that, in general, the more complex problems can be handled with greater facility and simplicity by using the electronic master-control system with the electronic splitters, totalizers, and other computing devices which are available with this medium. Thus a general conclusion reached is that the simpler problems are more economically solved by the use of pneumatic transmission and pneumatic master-control devices, while the more complex installations which require totalizing and computing devices and which must provide great flexibility, are most economically accomplished by means of the electronic master-control system.

There is no single control system which will most economically solve all multi-fuel problems. Each installation must be studied individually with its requirements and combinations of fuels and auxiliaries in order to produce the most economical and efficient system for the particular job.

Wood Technology

Furniture Core Panels of Wood Waste, by Armin Elmindorf, Chicago, Ill. 1952 ASME Fall Meeting paper No. 52—F-44 (mimeographed).

THIS paper describes the progress being made by manufacturers in the United States and Europe in the manufacture of wood-waste core boards. According to the paper the use of shavings cut from the edges of veneer waste is being given consideration by manufacturers having a continuous supply of veneer waste available, but at the present time most of the shavings are still cut from small logs or other solid wood by means of special machines. The European trend has been toward greater utilization of solid wood by conversion into thin special shavings, while the trend in the United States is toward the utilization of more comminuted wood such as sawdust by conversion into fine wood particles.

The paper gives a brief description of the steps involved in the manufacture of wood-shavings boards and suggests some requirements for a satisfactory core panel.

A rapid growth in the manufacture and use of wood-waste core board by the furniture industry is foreseen in the future because of its advantages over lumber core and the "block board." However, according to the paper, commercial

possibilities in the United States lie not only in the thick veneered panels of the furniture industry but also as a lower cost and superior base panel in place of thick plywood for hard plastic facing sheets.

From Handmade to Mass-Produced Wood Furniture, by N. C. Brown, New York State College of Forestry, Syracuse, N. Y. 1952 ASME Fall Meeting paper No. 52—F-30 (mimeographed).

FURNITURE, because of its long history, intimate association with daily living and personal comfort, enjoys a position of human interest transcending that of any other product of our expanding machine age. Its use and manufacture over the past century indeed have symbolized and mirrored the mechanical developments and industrial progress of this country. Throughout this century we have witnessed many changes in structural design, attractiveness, use of varied woods, manufacturing and assembling methods, and in volume of output in step with our expanding population and national income.

During the past century there has been a gradual development from the small handcraft shops making a few pieces of furniture per month to the larger establishment making thousands of finished pieces per month, finally to many of our great American plants each producing more than $1,000,000 worth per year. After the Civil War and notably during the period of 1870 to 1890, there was a marked expansion in the furniture business. With the introduction and use of veneers and plywoods, much of our furniture, particularly desks, bedroom suites, and tables, were made with fine veneers. Accompanying this came the imitation finishes of mahogany, walnut, and some other woods. As the population advanced westward the furniture business gradually moved to the Middle West and to the South which were nearer to sources of timber supply, enjoyed lower labor costs, and also provided lower transportation costs to markets.

Accompanying these changes from the bulging population and westward expansion of the eighties and the prosperous and gay nineties, there came about a change from the multistoried factories to one-story buildings to avoid the use of elevators and therefore reduce interdepartmental transportation costs about the plant. This type of building also provided for better lighting and ventilation facilities as well as for straight-line mass production. Concurrently there has come about a transition of location from the larger to the smaller communities in order to avoid traffic congestion and provide parking facilities during the automobile age of the past 20 years. These changes also provided more and better storage facilities for raw materials as well as for the finished product at lower overhead and rental costs.

Concurrently with these changes came a movement away from the classic designs and artistic beauty of manually made period furniture to the more livable, comfortable, and attractive product of the mechanized precision and mass-production stages of the present era.

Development of Materials for Wood-Cutting Tools, by E. K. Spring, Henry Disston & Sons, Inc., Philadelphia, Pa. 1952 ASME Fall Meeting paper No. 52—F-25 (mimeographed).

THE evolution of the cutting of wood has paralleled the pattern of other industries. Advantage has been taken of advancements in related fields and sciences. The early machine tools, being "slow," performed satisfactorily with band saws, circular saws, and knives made on carbon steel. When the need for higher-speed production was felt and machines were built to comply with that demand high-speed machines, which knew heavier loads on the cutting tools, were equipped with the improved products of the metallurgist.

Band saws have continued to be made of mildly alloyed steels. Their use and the method of maintaining them in usable condition appears to control the hardness at which they operate. The combination of these conditions does not indicate that a steel differing radically from those presently used would be applicable.

Circular saws for wood are different. The operations of mechanical flattening and tensioning, incident to manufacture and servicing in the field, have limited the hardness of the blade or body of the saw. However, increased life has been incorporated in the saw by the use, for the teeth, of steels which are better able to withstand service wear. A variety of schemes have been tried. Probably the first was to use replaceable teeth.

Knives for hogs, chippers, planers, shapers, and veneer cutters are frequently run at high speed. A planer or shaper today will commonly run at speeds which develop a temperature in the razor-sharp edge such as will draw the temper of the steel if it is not resistant to those temperatures. The author has seen knife-edges that have been reduced in hardness an appreciable amount in service, without discoloration of the wood. Hence it is necessary to use a high-speed steel capable of maintaining hardness at elevated temperatures.

Steels for this purpose may be of the older so-called 18-4-1 type (18 per cent tungsten, 4 per cent chromium, 1 per cent vanadium) or the newer types based on molybdenum rather than tungsten. With either type sufficient cobalt may be combined to affect the character of the steel.

With discovery of the beneficial effects of alloying agents, various combinations of nickel, silicon, chromium, vanadium, and molybdenum were used. In wood-cutting band and circular saws, carbon-nickel steel, with or without chromium and molybdenum, was and is popular.

The next advancement of the wood-working industry was the adoption of the so-called "high-speed steels." These steels contain large quantities of carbide-forming alloys.

Various methods of equipping tools with cutting edges capable of longer life have been tried such as the use of stellite, boron, and carbides. The present trend seems to be toward the sintered carbides.

A Century of Engineering in Wood Preservation, by G. M. Hunt, Forest Products Laboratory (retired), Madison, Wis. 1952 ASME Fall Meeting paper No. 52—F-22 (mimeographed).

THIS discussion of the development and growth of wood preservation in the United States is confined almost entirely to its use by the railroads, particularly in the treatment of crossties, because the main reliance of the wood-preserving industry has been upon the business provided by the railroads. Good statistics for the years before 1909 are not available but in that year crossties constituted about 82 per cent of the volume of wood treated by the industry. This was the situation again in 1914 and 1921. Since the latter year the proportion of other material treated has increased so that, in 1950, crossties and switch ties together constituted only about 41 per cent of the business. The railroads, however, are still the chief users of treated timber because, in addition to crossties, they use large quantities of treated switch ties, bridge ties, bridge timbers, piles, poles, fence posts, crossing plank, and construction lumber and timber for a great variety of purposes, as well as other material for miscellaneous minor uses.

The commercial wood-preserving industry, however, has been striving to diversify its business and to increase the proportion that comes from sources other than railroads. This effort, which has necessitated some radical changes in their methods of marketing their product,

has been attended with considerable success. Large quantities of wood are now treated for use as telephone and power-line poles, crossarms, wood-block flooring, foundation piles, farm and highway fence posts, piles and lumber for highway bridges, and harbor structures. Treated lumber, plywood, and laminated timbers are being used in homes and industrial buildings, and for a great variety of minor products. Impregnating wood with fire-retarding chemicals has also assumed sufficient importance to be included in the annual statistics of the industry, some 8 million board feet of lumber having been impregnated with such chemicals in 1950.

Discussion in this paper is limited to the impregnation of wood by pressure or hot-and-cold-bath methods. The bulk of the treating business of the country is done by such methods and the published statistics on the quantities of wood treated and preservatives used cover only material treated by these processes. The availability of pentachlorophenol as a toxicant, however, and the variety of solvents in which it can be carried, has made other treating business possible. For example, preservatives are now in use that contain 5 per cent of pentachlorophenol in a light-colored petroleum solvent, together with certain water-repelling ingredients. These are used to a considerable extent for the treatment of window sash, outside doors, and mill work by brief immersion. The treatment is helpful in reducing the number of premature failures of window sash in buildings, although such slight treatment usually cannot be recommended for severe exposures. Special equipment has been developed for treating the millwork conveniently and safely, some of which makes use of the low pressure developed by first drawing a vacuum and then admitting preservative solution at atmospheric pressure.

Solutions of copper naphthenate with additions of water-repelling materials also find limited use in nonpressure treatments although the cost and the green color of copper naphthenate solutions place them at a disadvantage for some purposes, particularly where substantial retentions are needed.

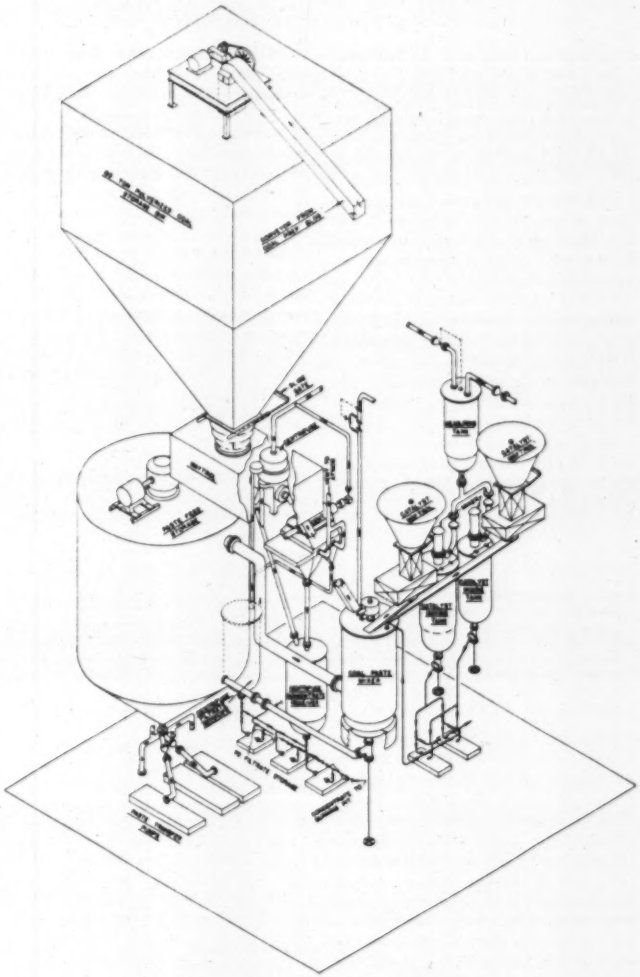
There is need for much further research to develop new and better preservatives, to reduce the cost of treated material, and to improve the methods of impregnating wood so that good penetrations can be obtained in heartwood and in the species that are now so resistant that deep penetrations cannot be insured without damage to the wood. Much time and money are being spent with these objects in view.

Petroleum Technology

Coal and Coal-Paste Preparation and Transfer Problems for Hydrogenation Service, by H. A. Remmert, L. C. Skinner, and J. T. Donovan, Synthetic Liquid Fuels Demonstration Plant, Fuels Technology Division, Bureau of Mines, Louisiana, Mo. 1952 ASME Fall Meeting paper No. 52—F-26 (mimeographed).

A DESCRIPTIVE discussion is given of the problems involved in continous preparation of sized pulverized coal, and coal paste, and its transfer as required in the coal-hydrogenation process. Coal drying, pulverizing, weighing, mixing coal and oils, and pumping the mixture at low and high pressure are included, as well as recommended piping and equipment design features. The information has been taken from collective experience and data obtained during operation of the Bureau of Mines Hydrogenation Demonstration Plant equipment. It considers the failures that occurred, the corrective measures taken, and the design essentials necessary for satisfactory operation.

It is concluded that many improvements are possible and needed in coal-preparation equipment to economically



DEMONSTRATION-PLANT PASTE PREPARATION

produce a finished product low in moisture, low in ash at 100 per cent minus-40-mesh. Coal hydrogenation presents new problems in the coal-preparation field, and much work can be done to determine the best process for a given installation.

Scalping of large particles from finely pulverized coal by means of screening is practical.

Separate coal-preparation and paste-preparation operations are practical to produce a consistent paste-oil product for the coal-hydrogenation process.

It is felt that satisfactory packing life is being achieved with centrifugal pumps in abrasive, heavy-oil service.

Corrosion and Erosion in the Synthetic-Fuels Demonstration Plant, by G. D. Gardner and J. T. Donovan, Synthetic Fuels Demonstration Plant, Fuels Technology Division, Bureau of Mines, Louisiana, Mo. 1952 ASME Fall Meeting paper No. **52—F-28** (mimeographed; to be published in Trans. ASME).

CORROSION and erosion during two years of intermittent operation of the first American coal-hydrogenation plant are described, as well as solutions and improvements developed.

Isolated cases of localized corrosion fatigue, caustic embrittlement, and pitting are described. Proper alloy-steel selection has minimized the effect of hydrogen attack in high-pressure equipment except where design temperature has been exceeded.

High-pressure lines and valves handling oil-solid mixtures containing absorbed gases have evidenced greatest erosion rates.

Recent Developments and Results at the Gas-Synthesis Demonstration Plant, Louisiana, Mo., by J. H. Sandaker, R. G. Dressler, and J. A. Markovits, Mem. ASME, Synthetic Fuels Demonstration Plant, Fuels Technology Division, Bureau of Mines, Louisiana, Mo. 1952 ASME Fall Meeting paper No. **52—F-27** (mimeographed).

THE Bureau of Mines operates at Louisiana, Mo., two demonstration-size synthetic-liquid-fuels plants for the conversion of coal to liquid fuels. One of them is a 200 to 300-bbl-per-day coal-hydrogenation plant, using the Bergius-I. G. Farben process with modifications.

The other, the gas-synthesis demonstration plant, is based on coal gasification and reaction of resulting synthesis gas in a modified Fischer-Tropsch process and was generally described at the 1950 ASME Petroleum Mechanical Engineering Conference. Since then, considerable experience in operation has been gained, and some major design changes have been made.

This gas-synthesis demonstration plant, designed to produce liquid fuels from CO-H_2-rich gas mixtures, is described, performance and process changes are explained stepwise from oxygen manufacture and pulverized coal gasification with oxygen and superheated steam through gas purification, synthesis and distillation. A short description of the catalyst preparation unit is included covering fusion, sizing, and reduction. Major items of equipment are discussed with emphasis on mechanical design features. The operating experience of the last two years is evaluated against the anticipated operations under the original design.

Materials Handling

Materials-Handling Factors Affecting Space Utilization, by Joseph E. Wiltrakis, Western Electric Company, Kearny, N. J. 1952 ASME Fall Meeting paper No. **52—F-51** (mimeographed).

THIS paper attempts to answer these questions: (1) Is the study of space utilization important to the introduction of efficient material-handling facilities? (2) Is there any relationship between material-handling factors and space utilization? (3) Is there a quick method of analyzing space utilization with the view toward determining criteria for the introduction of improved material handling? Greater savings may be possible, not only in labor, but also in other costs and in investment by making space-utilization studies concurrently with material-handling studies.

The conclusions reached are as follows:

1 Material handling is always a space problem. By studying space with material handling, an over-all view is obtained.

2 Material handling and space utilization objectives are essentially the same, namely, to provide facilities for the employee and inventory and to provide a factor for future conditions.

3 Quick methods for analysis are available by the use of a formula and graphic illustrations, such as the "area-gram." These assist in determining the maximum improvement to be sought, both in material handling and space utilization.

4 By comparing the actual utilization of space with the maximum possible, we often obtain criteria as to whether or not new methods should be sought. The objective, in all cases, should be the lowering of costs with safety to employee, at the same time maintaining quality and production.

5 Material handling and space utilization are improved by keeping inventory low and space utilization high.

ASME Transactions for October, 1952

THE October, 1952, issue of the Trans. ASME (available at $1 per copy to ASME members; $1.50 to nonmembers) contains:

TECHNICAL PAPERS

Recent Experience in Examination of High-Temperature Catalytic-Cracking Pressure Equipment, by D. B. Rossheim, J. J. Murphy, R. H. Caughey, and W. B. Hoyt. (51—A-26)

Frequency-Response Analysis for Industrial Automatic Control Systems, by D. W. St. Clair, W. F. Coombs, Jr., and W. D. Owens. (51—A-127)

The Effect of High-Frequency Sound Waves on an Air-Propane Flame, by C. J. Kippenhan and H. O. Croft. (51—A-112)

Photographic Analysis of Sprays, by J. L. York and H. E. Stubbs. (51—A-48)

Design and Performance of an Extended-Surface Regenerator for a Gas-Turbine Plant, by Sven Holm and R. L. Lyerly. (51—A-106)

Heat-Transfer and Flow-Friction Characteristics of Some Compact Heat-Exchanger Surfaces—Part 3, by A. L. London, W. M. Kays, and D. W. Johnson. (51—A-129)

Convective Heat-Transfer and Flow-Friction Behavior of Small Cylindrical Tubes—Circular and Rectangular Cross Sections, by W. M. Kays and A. L. London. (51—A-130)

Variation in Heat Absorption in a Natural-Gas-Fired, Water-Cooled Steam-Boiler Furnace, by A. R. Mumford and R. C. Corey. (51—A-147)

The New-Type Code Chart for the Design of Vessels Under External Pressure, by E. O. Bergman. (51—A-137)

A Procedure for Determining the Allowable Out-of-Roundness for Vessels Under External Pressure, by Marshall Holt. (51—A-136)

On the Accuracy of Extrapolated Creep-Test Relations for Plexiglas Subjected to Various Stresses, by Joseph Marin and Yoh-Han Pao.

Heat Transfer From Spheres to a Rarefied Gas in Supersonic Flow, by R. M. Drake, Jr., and G. H. Backer. (51—A-55)

An Experimental Investigation of Convective Heat Transfer to Air From a Flat Plate With a Stepwise Discontinuous Surface Temperature, by Steve Scesa and F. M. Sauer.

Dynamic Buckling of Thin Elastic Plates, by G. A. Zizicas. (52—S-3)

Friction Surfaces for Spin-Up Simulation in Landing-Gear Drop Tests, by D. W. Drake. (52—S-1)

The Mean Flow in Kaplan Turbines, by R. E. Meyer.

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Oil Specifications for Commercial Burners

MALCOLM B. MOYER[1]

This paper[2] presents an ideal in grades for fuel which will be difficult to attain. It overlooks the fact that fuel oil in the preheating grades is a residue and not a refined and graded product. Whoever burns this fuel must be prepared to adjust his burners to meet the individual qualities of each fresh batch of oil received from the marketer. This fuel is stored in limited quantities by relatively few inland marketers. In central New York the oil is delivered in barges during the summer and delivered by tractor tank trucks during the heating season. The bulk storage tanks of the marketer are filled with a number of barge loads, each of which varies to some extent from the others. It all goes to market as "bunker C" or No. 6. There is a growing demand for the new No. 4 which formerly was called "cold five." Some of the marketers have been blending No. 2 and their conglomerate No. 6 to deliver what they call No. 4. Most rotary-cup burners will burn this mixture without preheating but frequently give trouble in starting up cold.

At the present time the 1940 Code describing this oil has not been adopted fully and the phrase "cold No. 5" is still quite freely used. It would seem better to stabilize the present code before trying for a new one, and if changes must be made, let us keep in mind that finely drawn grades will be meaningless unless the marketers are willing to provide the tankage and trucks to store and deliver these extra grades. This does not seem possible in the foreseeable future.

COMMENT BY M. J. REED[3]

The author has presented some interesting possibilities for the revision of Commercial Standards CS 12-48 and his suggestions deserve careful consideration. There are several criticisms that can be offered for his attention.

He will find little support for his statements: "The lower the flash point, the easier it is to ignite the oil," and "An oil with a high flash point requires preheating in order to ignite it," unless he is speaking of ignition in the very restricted sense of ignition in a flash-point test apparatus. Certainly, ignition on actual burner installations is not governed by flash point.

Fallacious belief that flash point is an indication of the ease of ignition in actual installations is persistent in the field and frequently leads to unjustified complaints on fuel quality, particularly among dealers handling burners critical on ignition. The writer's company has found that a high ASTM 10 per cent point will cause ignition difficulties in such burners no matter how low the flash point may be. Conversely, a favorable 10 per cent point removes ignition difficulty even though the flash point may be relatively high. Ignition is a function of the "front-end volatility," which is indicated by the ASTM 10 per cent point. The author himself says that "flash point is not a reliable measure of volatility."

The 10 per cent point limit in the No. 2 grade in CS 12-48 was put in to safeguard performance on a type of burner that uses approximately one tenth of the No. 2 fuel-oil supply in the area east of the Alleghenies and to eliminate it might result in serious dislocations in the balance between No. 2 fuel and kerosene.

Raising the maximum viscosity of No. 2 fuel oil from 40 SSU at 100 F to 50 could result in serious difficulty should any appreciable part of the oil industry take advantage of it. It is doubtful if any oil-burner service man could arrive at a satisfactory burner adjustment if fuel-oil viscosity should fluctuate from 34 SSU to 50 SSU, in view of the fact, which is pointed out by the author himself, that high-pressure burner firing rate may be 25 per cent higher on 50 SSU fuel as compared to firing rate on 34 SSU fuel with no change in adjustments.

It is the writer's impression that the setting up of the No. 4 grade in CS 12-48 was to remedy the previous confusion between "cold" and "hot" No. 5 fuel by classifying the lighter product under the No. 4 grade. It may be, of course, that the No. 4 maximums and the No. 5 minimums were set too low, which suggests that the author could recommend that the dividing line between these grades be re-examined.

As a matter of fact, it appears that the recommendation for new grades Nos. 5, 6, and 7 is essentially a plea for remembering No. 4 as 5, No. 5 as 6, and No. 6 as 7. For example, the proposed No. 5 is CS 12-48 No. 4 with 10 deg lower pour point, 225 SSU higher limiting viscosity and with a 1.0 per cent max CCR on 10 per cent residuum (which hopefully assumes that 90 per cent of such heavy fuel could be distilled off without cracking). Proposed No. 6 is CS 12-48 No. 5 with 200 SSU higher minimum and 5 SSF higher maximum viscosity. Finally, proposed No. 7 is present No. 6 without a minimum flash point.

Would it not be simpler to recommend slight changes in present CS 12-48 standards without changing grade numbers that have a long custom of acceptance?

COMMENT BY KALMAN STEINER[4]

The oil-burner man is chiefly concerned with oil pumping and oil atomization. Hence the most vital characteristic of an oil, to him, is its viscosity. As regards No. 5 oil, a rule of thumb disposes of viscosity by the truism, "If an oil can be pumped cold, it can be atomized cold." The reference is to the horizontal rotary oil burner.

For years the Underwriters' Laboratories have listed horizontal rotary burners as being able to burn cold No. 5 and heated No. 6. For year CS12 Specifications referred to No. 5 as an oil to be burned without preheating. But in CS12-48, No. 5 is described a an oil requiring preheating. The Underwriters' approval has not changed. Hence we have the situation of burners being officially classified as being able to burn No. 5 oil cold, but No. 5 oil being officially classified as an oil requiring preheating.

[1] Consulting Engineer, Syracuse, N. Y. Mem. ASME.

[2] "Commercial Burner Oil Specifications," by J. V. Resek, MECHANICAL ENGINEERING, vol. 74, June, 1952, pp. 475-479.

[3] Product Engineering Division, Gasoline and Fuel Oil Department, Socony-Vacuum Oil Company, Inc., New York, N. Y. Mem. ASME.

[4] Consulting Engineer, C. Hoffberger Company, Baltimore, Md. Mem. ASME.

There are tens of thousands of installations of horizontal rotary burners designed for burning cold No. 5, mostly operating automatically. If refiners now offer only a No. 5 at the upper limits of permissible viscosity, all these burners will have to burn No. 4 (a higher-priced fuel), or be equipped with preheaters.

AUTHOR'S CLOSURE

The comments bring out some differences of opinion that can be resolved easily into oil specifications that are satisfactory and necessary to the oil industry, burner manufacturer, and to the public. These comments are greatly appreciated.

Mr. Moyer states that the proposed specifications are ideal but difficult to obtain in the case of residual oil. In many parts of the country residual oils are furnished to controlled specifications. Some of these are straight-run oils and some are obtained by diluting heavy residual fuel oil with "cutter" stocks. There is very little objection from the petroleum industry to changing the specifications to provide a more uniform and suitable fuel oil for the burners now being manufactured.

Mr. Reed's observations are both interesting and valuable. Most experts agreed with him that flash point is not an indication of the ease of ignition and it is certainly true that in certain types of burners difficulty is experienced in igniting oils with a 10 per cent distillation point higher than 440 F. Since it has been found that this distillation point is compatible with a viscosity of 40 sec Saybolt Universal at 100 F, it will be noted that the specifications proposed in the paper limit the maximum viscosity of No. 2 oil to 40 SSU. It will be noted that this is a change from the original preprint wherein 50 F was suggested. Maximum flash point is not limited in any of the specifications.

It is immaterial whether the proposed No. 5 oil is called No. 4 or No. 5. It is important that an oil of these specifications be available and that the customer be able to order this oil by number. The writer prefers the designation No. 5 for this oil because it is probable that most of the oil in this grade will fall in the range of the present No. 5 oil and because industrial burner manufacturers now sell burners to burn "Cold No. 5 Oil." This oil is heavier than present No. 4 but in the lower range of the present No. 5 oil. Using the new specifications, these burners would continue to be called "No. 5 Oil Burners" instead of changing their well-known designation to "No. 4 Oil Burners." There are no burners on the market designed to burn the present no. 4 oil.

The proposed specifications make very few changes in the grades of light oil but correct the improper specifications of the heavier oil and limit No. 5 oil so it need not be heated in order to flow readily to a burner and so that it can be burned cold in those burners that are sold to burn No. 5 oil without preheating. Making these changes leaves a very wide range for No. 6 oil and it is proposed that this be broken down into two grades, No. 6 and No. 7.

Mr. Steiner's comment regarding the comparison between the listing of the Underwriters' Laboratories and CS12 Specifications is very apt. These new specifications will give us an oil that is proper to be used in a burner approved by the Underwriters for that grade.

The Underwriters' Laboratories, the oil refineries, the burner manufacturers, and the public can all refer to an oil by specification number and they will all be talking about the same thing.

J. V. RESEK.[5]

[5] Manager, Oil Burner Division, Cleaver-Brooks Company, Milwaukee, Wis. Mem. ASME.

I Agree!

TO THE EDITOR:

Please accept my congratulations for publishing Professor Robert L. Shurter's article. It presents, in my opinion, the most welcome criticism of our present-day dry technical literature. The idea propounded by Professor Shurter of writing papers in personal style is by no means new. Some hundred years ago it had been quite universally used by the authors of scientific papers. It is sufficient to open the annals of any scientific journal of that time or of one which maintains the tradition, such as the "Proceedings of The Royal Society," to see how much more enjoyable is the reading of papers written in personal form than of the dry technical essays of today. Professor M. Born describes, for example, the objective of his paper, written in 1941,[6] as follows:

"The purpose of the present paper is a double one: *I wish* to remove the discrepancy of opinion. . . ." and "in the rest of the paper *I shall* supplement the theory. . . ."

It seems to me that the author can present his arguments more forcefully in this way than by covering his statements with the "straight jacket" of the formal style. Unfortunately, as Professor Shurter pointed out, we are restricted by instructions received from the editors of technical journals. Our own ASME Manual[7] states in this respect:

"The use of the first person and reference to individuals always should be made in such a manner as to avoid personal bias."

Although this is not expressed as a strict rule, it is difficult to understand what is meant by the "personal bias" and the obvious conclusion to which most of the authors arrive is to simply avoid the first person. So, even if an author agrees with Professor Shurter's opinion, there is very little he can do about it unless the rules of the manuals will be revised and the paper committees properly instructed that the "straight jacket" is off. But this, I believe, can be done only by the editor—so, it seems, the next move is up to you, Sir.

A. K. OPPENHEIM.[8]

[6] "Proceedings of The Royal Society of London," Series A. vol. 180, p. 397, 1942.

[7] "An ASME Paper Its Preparation, Submission, and Publication and Presentation," Board on Technology, The American Society of Mechanical Engineers, June, 1947.

[8] Assistant Professor of Mechanical Engineering, University of California, Berkeley, Calif. Mem. ASME.

Operating Experiences With Cyclone-Fired Steam Generators[9]

COMMENT BY R. M. VAN DUZER, JR.[10]

In a paper[11] presented at the 1950 Annual Meeting of the ASME, a method of conditioning combustion air for a large underfeed stoker was described which has nearly eliminated fireside tube deposits. This humidification of the combustion air has materially reduced cleaning expense and greatly increased the boiler availability.

It would be interesting to know if the authors of the present paper[9] and their associates have controlled the combustion air humidity and, if so, with what results. It would appear that the slagging described is more the result of a chemical phenomenon rather than me-

[9] "Operating Experiences With Cyclone-Fired Steam Generators," by V. L. Stone and I. L. Wade, MECHANICAL ENGINEERING, vol. 74, May, 1952, pp. 359–368.

[10] Asst. Chief Engineer of Power Plants, The Detroit Edison Company, Detroit, Mich. Mem. ASME.

[11] "Fireside Deposits on Steam Generators Minimized Through Humidification of Combustion Air," by Paul Murphy, Jr., J. D. Piper, and C. R. Schmansky, Trans. ASME, vol. 73, 1951, pp. 821–843.

chanical, similar to that described in the foregoing reference.

The value of the paper would have been enhanced had the authors included steaming availability figures. These installations are commercial installations and it is suspected have carried their share of load in spite of troubles, so well described in the paper.

AUTHORS' CLOSURE

During August, 1951, a series of 18 tests were conducted on a cyclone-fired boiler at the Joliet Station of the Public Service Company of Northern Illinois by The Babcock & Wilcox Company, and the station personnel, to determine the effects of humidifying combustion air on superheater ash deposits. The effects were measured by two short-time test tools—these were a Delray ash-deposit probe and a fume-absorption train. Numerous samples of coal, slag, and fly ash were also taken and analyzed. Due to the limitation of the test tools these short-time tests were not consistent in their findings, but indications are that humidification of combustion air does not affect superheater ash deposits when burning Central Illinois coal on cyclone-fired boilers.

V. L. STONE.[12]
I. L. WADE.[13]

[12] Superintendent of Generating Stations, Commonwealth Edison Company, Chicago, Ill. Mem. ASME.
[13] Manager of Stations and Substations, Public Service Company of Northern Illinois, Chicago, Ill. Mem. ASME.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Modern American Engineers

MODERN AMERICAN ENGINEERS. By Edna Yost. J. B. Lippincott Company, Philadelphia, Pa., 1952. Cloth, 5¼ × 8 in., ix and 182 pp., $2.50.

REVIEWED BY R. C. GOODPASTURE[1]

AN issue of paramount importance to the engineering profession in this centennial year is how to fully apprise the laymen of the nature and diversity of engineering activities. It is a regrettable fact that even among the intelligentsia there is widespread misunderstanding as to the stuff of which engineers are made. As is often the case, the key to this riddle is a well-informed youth. In "Modern American Engineers" Edna Yost has given her precollege readers twelve subject lessons on men's activities in different fields of engineering, and at the same time she has presented to older folk a fascinating book about success Americana.

By offering each biographic sketch as a story unto itself, Miss Yost has prepared a thoroughly absorbing book which can be conveniently picked up for either a long or a short reading session. The life stories are not pictured in the formalized manner of "Who's Who," but rather with the warmth and personal touch which is essential in explaining the character and heart behind the distinguished accomplishments described in this book. After all, Robert Doherty had to participate in a full and well-rounded life before he was able to visualize and develop the "Carnegie Plan" which made him famous; Ralph Flanders found that years as a practicing mechanical engineer gave him a sound and compatible background for service in the United States Senate. Facts such as these are the kind of material which the authoress has skillfully woven into each of the dozen biographies.

The engineering reader can't help but be impressed with Miss Yost's flair for grasping the very mental process of the engineers she interviewed, then extracting the salient points, and through them giving a sparkling, clear picture of the man and his ideas. Admittedly, no attempt was made to select the twelve most outstanding engineers of the age; but rather, these men were chosen because of the variety of their interests and the common thread of marked success in all their stories. Inclusion of such notables as Vannevar Bush and Ole Singstad is full evidence, however, of the high caliber of men discussed.

An avowed purpose of "Modern American Engineers" is to stimulate in young people an interest in the profession, to the extent that they may choose to study engineering. This is a noble goal, and many young readers will certainly picture themselves someday tasting the success which Miss Yost's engineers have already savored. This is a healthy situation because, for many, the apparent idle dreams of today become the driving incentives of later years. A number of direct quotations throughout the book are particularly timely, and add measurably to the stature of the publication. An example is Scott Turner's advice to young engineers, "Study facts, analyze information, get advice. But the final decision on any next step is yours alone. Take it—and go ahead. Don't look back or take time to be sorry."

Many of the biographies included by Miss Yost are of men who, from their youth, knew instinctively that they wanted to be engineers. This is an unfortunate coincidence, because most teenagers don't have such an intuitive knowledge. It is conceivable that a young reader who has not yet felt this urge toward engineering might, therefore, dissuade himself for fear that success and happiness are beyond his grasp in a field which he does not have a great compulsion to enter. Nothing could be further from the truth.

The reviewer would add one other constructive criticism of Miss Yost's book. Following a belief quite common among laymen, she has overemphasized the necessity of ". . . plenty of mathematics . . ." in the engineering profession. In many places she made this mistake, in one case noting that John Suman knew he ". . . would need mathematical ability of a high order . . ." if he was to take up mining engineering at college. The reviewer does not presume to pass judgment on the amount of mathematics used in the study and practice of mining engineering, and he acknowledges that some advanced and highly specialized fields of engineering require considerable ability in mathematics. But to risk the danger of implying that this is a prerequisite of all branches of engineering is a grave error. Mathematics is a tool to be used by the engineer, but outstanding ability along these lines is not imperative. Men who rise to enviable heights in engineering often are in a position to hire others to manipulate the mathe-

[1] Engineer, Sanderson & Porter, New York, N. Y.

matical and mechanical devices used in the solution of their problems.

Notwithstanding the two latter comments, "Modern American Engineers" will certainly accomplish its announced objective, that of interesting precollege students in engineering. This book has a freshness and a humanistic approach which combine to picture the engineer as he himself would wish to be described. People of all backgrounds and interests should find this book a source of satisfaction and pleasure.

Books Received in Library

ANNUAL REPORT OF THE PROGRESS OF RUBBER TECHNOLOGY. Volume 15, 1951. Edited by T. J. Drakely. Published by W. Heffer & Sons Ltd., for the Institution of the Rubber Industry, London, England. Bound, $7\frac{1}{2} \times 10$ in., 135 pp., £1, 1s. Beginning with an historical and statistical review, this report proceeds to deal briefly with the following: planting and production of raw rubber and related products; physics and chemistry of raw rubber and rubberlike substances; synthetic rubber; manufactured rubber products such as tires, cables, and electrical insulation, mechanical rubber goods, textile-rubber composites, cellular rubber; and machinery and appliances. Author and subject indexes are provided for the more than 900 articles cited.

ANNUAL REVIEW OF NUCLEAR SCIENCE. Volume 1. Annual Reviews, Inc., Stanford, Calif., 1952. Bound, $6\frac{1}{4} \times 9$ in., 645 pp., charts, tables, graphs, $6.50. This is the first of a series designed essentially to survey the literature in the field. The authors of the several papers, dealing with a wide range of topics from meson physics to low-temperature phenomena and radioisotope uses, were required not only to cover the outstanding developments but also to provide sufficient background material to make possible a critical appraisal of the current status of the subject matter. Reference is made throughout each article to its accompanying bibliography.

APPLIED STRUCTURAL DESIGN. By Thomas H. McKaig. Published by the author, 881 Main Street, Buffalo 3, New York, N. Y., 1949. Bound, $8\frac{3}{4} \times 11\frac{1}{4}$ in., 505 pp., tables, charts, diagrams, $10. The general arrangement of this manual carries the subject from the mathematics and mechanics of structural engineering through the theory of bending into the practical application to building problems. Expanded from a series of preparatory notes for state-license examinations, the book contains the tabular and graphical information which the author has had most occasion to use in actual practice. The methods and basic data used are in accordance with prevailing standard building codes. The book is intended as a practical handbook for the structural designer rather than as a textbook.

AUTOMATIC AND MANUAL CONTROL. Edited by A. Tustin. Conference on Automatic Control organized by the Department of Scientific and Industrial Research. Academic Press Inc., New York, N. Y., 1952. Bound $7\frac{1}{2} \times 10$ in., 584 pp., diagrams, graphs, charts, tables, $10. This collection of conference papers is intended to provide a work of reference for those engaged in the design of control equipment, and to serve as a source of information for those with some knowledge of basic principles who wish to extend their knowledge in various more specialized directions. The major sections deal with the general theory of servomechanisms, feedback control, and so on; with process-control analysis; with the aspects designated as nonlinear problems; and with systems working on intermittent data and step-by-step servos. Special papers deal with educational problems, the human operator, and particular devices and applications including analogs.

CALCULUS OF VARIATIONS. With Applications to Physics and Engineering. By Robert Weinstock. McGraw-Hill Book Company Inc., New York, N. Y., first edition, 1952. Bound, $6\frac{1}{4} \times 9\frac{1}{2}$ in., 326 pp., $6.50. Following a brief treatment of the classical elementary problems, this book provides sections involving the role of the calculus of variations in particle dynamics, geometrical optics, quantum mechanics, elasticity, electrostatics, and in the eigenvalue problems associated with the vibrating string and vibrating membrane. Techniques and underlying ideas are emphasized.

COLD WORKING OF NON-FERROUS METALS AND ALLOYS. The Institute of Metals, London, England (Monograph and Report Series No. 12), 1952. Bound, $5\frac{3}{4} \times 8\frac{3}{4}$ in., 207 pp., tables, illus., charts, diagrams, $2.50. The following five papers comprise a symposium on the metallurgical aspects of the general subject: fundamental aspects of the cold-working of metals; lubricants for the cold-working of nonferrous metals; cold-rolling of nonferrous metals in sheet and strip form; wire-drawing technique and equipment; deep drawing and pressing of nonferrous metals and alloys. Current practice in the processes considered is effectively outlined. The general discussion of the papers is included in the book.

CORROSION TESTING PROCEDURES. By F. A. Champion. John Wiley & Sons, Inc., New York, N. Y., 1952. Bound, $5\frac{3}{4} \times 8\frac{3}{4}$ in., 369 pp., tables, charts, diagrams, $6.25. Intended mainly for the investigator concerned with practical problems in the corrosion of metals in service and the production of corrosion-resistant metal, this manual covers in detail the alternative procedures for all stages of corrosion tests: choice and preparation of metal and corrosive agent; exposure conditions for both laboratory or field tests; examination of specimens or corrosive agent for effects of corrosion; expression and interpretation of results with particular reference to the corrosion/time curve. Various special tests are considered separately.

FAULT CALCULATIONS. By C. H. W. Lackey. Oliver & Boyd Ltd., Edinburgh, Scotland, 1951. Bound, 6×9 in., 296 pp., diagrams, illus., charts, 30s. The elements of various calculation techniques are set out in the first part of the book, particular stress being laid on their practical application. Another section outlines the nature of the impedances of machines, transformers, overhead lines and cables, gives typical values, and includes tables and nomograms so that particular impedances may be calculated from known physical dimensions. A final chapter is included on the subject of fault-calculators and network-analysers. The book is intended both as a text for students and a reference work for power-system engineers.

INDUSTRIAL WASTE TREATMENT. By Edmund B. Besselievre. McGraw-Hill Book Company, Inc., New York, N. Y., first edition, 1952. Bound, $6\frac{1}{4} \times 9\frac{1}{4}$ in., 391 pp., illus., diagrams, tables, $7. Beginning with discussion of the nature, cause, and general aspects of an industrial-waste problem, the author first establishes basic methods of approach to a solution. Technical subjects covered include sampling and analysis of wastes, pollutional effects, methods of waste treatment, handling methods, and the recovery of usable materials. Legal factors and economic aspects are thoroughly covered.

INITIATION AND GROWTH OF EXPLOSION IN LIQUIDS AND SOLIDS. By F. P. Bowden and A. D. Yoffe. Cambridge University Press, New York, N. Y., 1952. Bound, $5\frac{3}{4} \times 8\frac{3}{4}$ in., 104 pp., illus., tables, diagrams, charts, $4.50. This study of decomposition by impact and by friction of explosive substances deals mainly with the work of the authors and their collaborators. Research is still in progress but results to date indicate that the mechanism of initiation is relatively simple. These findings are thoroughly discussed, and the latter part of the monograph describes the way in which a small nucleus of decomposition can grow into a large-scale explosion.

INSTRUMENT ENGINEERING. Volume 1: Methods for Describing the Situations of Instrument Engineering. By Charles Stark Draper, Walter McKay, and Sidney Lees. McGraw-Hill Book Company, Inc., New York, N. Y., first edition, 1952. Bound, $9 \times 11\frac{1}{4}$ in., 269 pp., charts, graphs, tables, diagrams, $6. The complete three-volume set is to present a generalized method of attack on the problems of measurement and control as a comprehensive reference for the practicing engineer or an extensive textbook. Vol. 1 develops a system of concepts, notations, diagrams, and mathematical forms for describing the performance of physical devices and variations in physical quantities. It provides a description of the physical circumstances under consideration by means of diagrams, mathematical forms, curves, and numerical data.

DIE KENNLINIEN EINER FREISTRAHLTURBINE IM TRIEBGEBIET SOWIE IM BREMSGEBIET UND DIE WIRKUNGSGRADE IM TRIEBGEBIET. By Jagdish Lal. Springer-Verlag, Vienna, Austria, 1952. Bound, $6\frac{3}{4} \times 9\frac{1}{2}$ in., 118 pp., charts, tables, graphs, diagrams, $3.50. This publication analyzes the characteristics of an impulse turbine during driving and during braking, and its efficiency during driving. It particularly treats unusual conditions of negative peripheral speed, overdrive, and reversed mounting. The discrepancy between theoretical and experimental results is discussed.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

MACHINERY AND EQUIPMENT FOR RUBBER AND PLASTICS. Volume 1: Primary Machinery and Equipment. By Robert G. Seaman, editor, and Arthur M. Merrill, associate editor, *India Rubber World*, New York, N. Y., 1952. Bound, $6^1/_4 \times 9^1/_4$ in., 804 pp., tables, diagrams, $15. The complete two-volume set is intended to provide the rubber and plastics industries with classified information for their manufacturing operations on what machines are available for use, how they work in the manufacture of the finished products, and where they may be obtained. This first volume covers primary equipment: mills, mixers, calenders, extruders, presses, and so on, and the special machines used for the manufacture of tires and tubes, hose and belting, footwear, wire and cable, latex goods, and plastics film and sheeting. Each classified section begins with a general-summary article, written by a specialist, which describes procedures and operations as well as the machinery involved. The second volume is to cover supplementary machinery and equipment.

MEASUREMENT AND CONTROL OF TEMPERATURES IN INDUSTRY. By R. Royds. Chemical Publishing Company, Inc., New York, N. Y., 1952. Bound, $5^3/_4 \times 8^3/_4$ in., 260 pp., charts, diagrams, tables, illus., $5. Covers the latest developments for maintaining high thermal efficiency as utilized in a wide variety of industries. The various methods and equipment available for the measurement of temperatures in each particular range are discussed. Considerable space is devoted to the standardization and automatic control of temperatures. Attention is given to improving product quality, increasing production rates, and the saving of fuel and labor by the application of automatic temperature controls.

METALLURGY FOR ENGINEERS. By John Wulff, Howard F. Taylor, and Amos J. Shaler. John Wiley & Sons, Inc., New York, N. Y., 1952. Bound, $5^3/_4 \times 8^1/_2$ in., 624 pp., diagrams, charts, tables, graphs, $6.75. Intended to give the reader an adequate understanding of metals for their intelligent selection and use, the first half of the book explains the concepts and principles that underlie metal processing from the ingots to the finished articles of commerce. The second half deals with the processes themselves: casting, welding, metalworking, metal cutting, and powder metallurgy. The emphasis throughout is from the engineering rather than the shop viewpoint.

REFRIGERATION DATA BOOK. BASIC VOLUME. American Society of Refrigerating Engineers, New York, N. Y., seventh edition, 1951. Bound, $6^1/_2 \times 9^1/_2$ in., 688 pp., 218 pp., illus., tables, charts, diagrams., graphs, $7.50. This biennial reference book provides comprehensive coverage of refrigeration design, theory, thermodynamics, refrigerant properties, and related topics, the several chapters being written, as before, by authorities in the respective fields. A classified buyers' guide is also included. The complementary volume on practical applications appears in the alternate years to round out the full treatment.

RESIDUAL STRESS MEASUREMENTS. By R. G. Treuting, J. J. Lynch, H. B. Wishart, D. G. Richards. American Society for Metals, Cleveland, Ohio, 1952. Bound, $6^1/_4 \times 9^1/_4$ in., 210 pp., illus., charts, graphs, $4.50. Four authorities in the field discuss the following subjects: nature, origin, and effects of residual stresses; measurement of residual stresses; residual-stress states produced in metals by various processes; relief and redistribution of residual stresses in metals.

SCIENTIFIC PAPERS OF JAMES CLERK MAXWELL. Edited by W. D. Niven. Dover Publications, Inc., New York, N. Y. Two volumes bound in one. 607 pp., 806 pp., diagrams, illus., tables, $10. This reprint of the definitive edition of 1890 contains all the published papers, lectures and addresses, essays, and short treatises of one of the great theoretical physicists of the nineteenth century. These clear and vigorous expositions of fundamental physical theory and experiment cover a broad range of subject matter and are still useful to the student or physical investigator.

STATISTICAL QUALITY CONTROL. By Eugene L. Grant. McGraw-Hill Book Company, Inc., New York N. Y., second ed., 1952. Bound, $6^1/_4 \times 9^1/_4$ in., 537 pp., graphs, illus., tables, $6.50. This book deals with the laws of probability that may be used to improve acceptance procedures and thus secure the best possible quality assurance from a given inspection cost. It explains the Shewhart control chart and its use in manufacturing to reduce costs of spoilage and rework, and to obtain better coordination among design, production, and inspection. The explanation of basic principles is accompanied by numerical examples demonstrating the usefulness of these techniques in dealing with quality problems in mass production. The revision includes procedures used by the military services.

STATISTICAL THEORY WITH ENGINEERING APPLICATIONS. Bound, $6^3/_4 \times 10^1/_4$ in., 783 pp., charts, tables, $9. STATISTICAL TABLES AND FORMULAS. Paper, $8^3/_4 \times 11$ in., 97 pp., tables, $2.50. Both by A. Hald, 1952, John Wiley and Sons, Inc., New York, N. Y. The author's aim has been to cover a large part of the theory developed during the past fifty years and proved to be of practical value. The subject is treated necessarily from a mathematical standpoint, but each important theorem or aspect is illustrated with examples from actual experience. The main stress is laid on the normal distribution and the tests of significance connected with it. Published in conjunction with the text is a separate volume containing a comprehensive set of statistical formulas of practical importance and tables containing standard statistical functions. In addition to the full treatment in the book itself a great many notes and references to further material on the subject are included.

STEAM POWER PLANTS. By Alexander H. Zerban and Edwin P. Nye. International Textbook Company, Scranton, Pa., 1952. Bound, $6^1/_4 \times 9^1/_2$ in., 524 pp., tables, diagrams, charts, illus., $7.50. A comprehensive treatment of the mechanical-engineering fundamentals of steam-power plants. Special attention is paid to the matter of heat transfer in power-plant processes, and the reasoning behind the latest types of steam-generator design is explained with regard to these heat-transfer requirements. Other features of the book are the treatment of meters and controls and the relating of all phases of power-plant operation to the economic aspects, citing actual examples and solutions.

STEEL DEFECTS AND THEIR DETECTION. By Henry Thompson. Sir Isaac Pitman & Sons, Ltd., London, England, 1952. Bound, $5^3/_4 \times 8^3/_4$ in., 85 pp., illus., charts, diagrams, 15s. This concise reference work gives a description of the characteristic common defects associated with steel ingots and with the rolling processes. Both macroscopic and microscopic tests are described and the microscopic constituents of steel are noted and illustrated. Special methods are covered in the last chapter: magnetic, fluorescent, electronic, and supersonic flaw detection; spark testing and magnetic sorting.

TABLES OF COULOMB WAVE FUNCTIONS. Volume 1. (Applied Mathematics Series 17.) National Bureau of Standards, Washington, D. C., 1952. Bound, $8 \times 10^1/_2$ in., 141 pp., tables, $2. Continuing this series of publications from the National Applied Mathematics Laboratories, the present volume presents a group of special functions of particular use in the fields of nuclear physics and astrophysics. An extensive explanatory introduction and a list of literature references are also included.

UNITED NATIONS STATISTICAL YEARBOOK. Prepared by the Statistical Office of the United Nations, Department of Economic Affairs, third issue, 1951. Paper, $9 \times 11^1/_2$ in., 616 pp., tables. Available from Columbia University Press, New York, N. Y. $6. Prepared by the Statistical Office of the U. N. Department of Economic Affairs, this compilation provides yearly statistics for the approximate period 1930 to 1950 for all countries for which figures were available. Subject fields covered include population, agriculture, mineral industries, manufactures, transport, commerce, and education. It is the aim of the yearbook to present for the various countries, over the period covered, continuous time series which are comparable internationally. All explanations and tabular designations, as well as the subject and country indexes, are printed in both English and French.

ASME BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting July 30, 1952, and previously, and approved by the Board, Oct. 1, 1952.)

CASE No. 1155

(Interpretation of Par. P-291)

Inquiry: May compensated manometric remote type level indicators be used in place of the gage glasses specified in Par. P-291 for measuring boiler drum water levels?

Reply: It is the opinion of the Committee that two independent remote level indicators of the compensated manometric type may be used instead of one of two required gage glasses for boiler drum water level indication in the case of power boilers with all drum safety valves set at or above 900 psi. When both remote indicators are in operation, the gage glass may be shut off but shall be maintained in serviceable condition.

The remote indicators shall not depend for operation upon any external source of energy. Connections to the drum shall comply with present rules Par. P-293 and P-320 for water columns and shall be completely independent of connections for other functions.

CASE No. 1157

[Interpretation of Par. UA-6(c)]

Inquiry: In view of the revision of Par. UA-6(c) which has been approved for inclusion in the 1952 edition of the Code may the intent of this change be applied to spherically dished bolted covers constructed to the 1950 Code?

Reply: It is the opinion of the Committee that in lieu of Par. UA-6(c) of the 1950 Code the following may be substituted:

(c) *Heads Convex to Pressure.* Circular spherically dished heads convex to pressure with bolting flanges shall be designed by the formulas in this paragraph except that the thickness of the head "t" shall not be less than required by Par. UG-33 for the type of head used (for details B, C, and D the head shall be taken as hemispherical having the radius L, Fig. UA-6, in applying the rules of Par UG-33).

CASE No. 1158

(Special Ruling)

Inquiry: May ASTM Specification A-212-52aT, High Tensile Strength Carbon-Silicon Steel Plate, be used in boilers and pressure vessels in lieu of Specification SA-212?

Reply: Revised 1952 Section II will contain Specification SA-212 corresponding to Specification ASTM A-212-52aT. It is the opinion of the Committee that the intent of the Code will be met by the use of this latest form of Specification SA-212-49T.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code

AS need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism.

If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code. Simple changes are indicated directly. In the more involved revisions added words are printed in SMALL CAPITALS; deleted words are inclosed in brackets [].

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Power Boilers, 1949

*PAR. P-23(a). Substitute the following for the present formulas and descriptions:

$$t_m = \frac{PD}{2S + 2yP} + C$$

$$P = \frac{S}{\frac{1}{2}\left(\frac{D}{t_m - C}\right) - y}$$

where t_m = minimum pipe wall thickness in inches.[1]

The minimum thickness used in the formula shall in no case be more than the minimum thickness resulting from the application of the tolerances given in the Code specification for the material to be used, including tube material which is to be used for piping.

P = maximum internal service pressure, pounds per square inch, at the operating metal temperature for which the value of S is taken from Table P-7.[2] The value of P in the formula shall not be taken at less than 100 for any condition of service or material,

D = outside diameter of pipe, inches,

S = allowable stress due to internal pressure at the operating temperature in the material, pounds per square inch (See Table P-7 and note 1, page 17),

C = allowance for threading, mechanical strength, and/or corrosion, inches,

y = a coefficient having values as follows:

Temp F	900 and below	950	1000	1050	1100	1150 and above
Ferritic steels	0.4	0.5	0.7	0.7	0.7	0.7
Austenitic steels	0.4	0.4	0.4	0.4	0.5	0.7

Material Specifications, 1949

EDITORIAL NOTE

The Boiler Code Committee has approved adding Section II of the following new specification:

SA-278-51T, Specification for Gray Iron Castings.

Unfired Pressure Vessels, 1950

PAR. UW-10(e) Delete and substitute:

(e) The joint efficiency permitted for stress-relieved vessels in Par. UW-12 may be applied to any part of a vessel that is stress-relieved, provided:

(1) The joints connecting a stress-relieved part to other stress-relieved parts are stress-relieved;

(2) Any joint connecting a stress-relieved part to a non-stress-relieved part is stress-relieved in the following cases:

(*a*) When the service, material, and thickness of the stress-relieved part at the joint are such that stress-relief is required by Pars. U-2(f), UG-67(c), UW-2(b)(1) or UW-10(a), (b), (f);

(*b*) When the thickness of the non-stress-relieved part is equal to or greater than the thickness of the stress-relieved part.

PAR. UW-10(h) Delete.

PAR. UW-40(c) Revise to read:

The minimum temperature for stress-relief given above shall be the minimum temperature of the plate material of the shell or head of any vessel. Where more than one pressure vessel or pressure vessel part are stress-relieved in one furnace charge, thermocouples shall be placed on vessels at the bottom, center and top of the charge, or in other zones of possible temperature variation so that the temperature indicated shall be the true temperature for all vessels or parts in those zones.*

PAR. UA-6(c) Completely revise as follows:

(c) *Heads Convex to Pressure.* Circular spherically dished heads convex to pressure shall be designed by the formulas in this paragraph, and the thickness of the spherical segments shall be increased if necessary, to meet the requirements of Par. UG-33. (For details B, C, and D the head shall be taken as hemispherical in applying the rules of Par. UG-33.)

* This replaces the revision printed in MECHANICAL ENGINEERING, September, 1952.

* Furnace gas temperature measurement alone is not considered sufficiently accurate.

ASME NEWS

With Notes on the Engineering Profession

ASME 1952 Annual Meeting Program Plans Aim at Record for Scope and Size

Statler and McAlpin Hotels, Nov. 30–Dec. 5

BUILDING for the Future of America is the theme of the 1952 Annual Meeting of The American Society of Mechanical Engineers to be held at the Statler and McAlpin Hotels, New York, N. Y., Nov. 30–Dec. 5, 1952.

This year's record program is greater in volume and variety than ever before. With 97 technical sessions, inspection trips, and many social events, it is designed to cover in a large measure the diversified interests of an ever-growing membership. The meeting should be of tremendous value to the professional engineer in pursuing research data on his current projects and furthering information for new interests, not to mention the pleasure and benefit of exchanging ideas with his fellows. The professional divisions are participating both by technical sessions and symposiums.

The technical program was published on pages 841–846 of the October issue of MECHANICAL ENGINEERING. Members are urged to review the program to remind themselves of the wealth of material to be presented. Some of the high lights of the Annual Meeting follow.

Symposiums and Panels

The symposiums and panels keep growing in popularity. These informal discussions of timely topics are often an expression of opinion or experience and have a characteristic crisp "freshness" and spontaneity. The Aviation and Materials Handling divisions have planned a series of such meetings on the following subjects: Air-cargo terminal requirements, international air-cargo trends, and air transportability. The Heat Transfer Division lists a symposium on materials problems in heat-exchanger design and one on heat exchangers. The Management Division has prepared a panel on economic, social, and technical aspects of the automatic factory, with discussers from the industrial and educational fields. Also, with the Junior Committee they plan to present the 1952 ASME 10-year progress report in management. The Power and Management divisions will cosponsor the panel on industrial power-plant costs. Other divisions of the Society will have discussion groups, such as: Wood Industries panel on materials handling, seasoning, sawmilling, finishing, and plastics; Education, Industry's Stake in the Secondary School; Fluid Meters symposium on inferential flowmeter measuring tolerances and errors. There will also be panels on oil and gas power, gas-turbine power and hydraulics, and lubrication and machine design.

Annual Banquet

The gala event of every Annual Meeting is the banquet, at which time ASME will introduce the new officers for the coming year, salute the members who have made outstanding contributions to the administration of the Society, and honor the distinguished guest and mechanical engineers who have been chosen for awards for their splendid contributions to the profession. Prof. J. M. Lessells, editor, *Journal of Applied Mechanics*, and Prof. S. P. Timoshenko will be greeted as this year's honorary members. Other important honors include the following: ASME Medal to N. F. Funk; Holley Medal to S. L. Cluett; Worcester Reed Warner Medal to Max Jakob; Melville Medal to N. P. Bailey; Junior Award to W. M. Rohsenow; Richards Memorial Award to J. H. Davis; and Pi Tau Sigma Gold Medal Award to H. L. O'Brien.

Registration Schedule

Sun., Nov. 30	2:00 p.m. to 5:00 p.m.
Mon., Dec. 1	8:00 p.m. to 8:00 p.m.
Tues., Dec. 2	8:00 p.m. to 8:00 p.m.
Wed., Dec. 3	8:00 p.m. to 4:00 p.m.
Thurs., Dec. 4	8:00 p.m. to 8:00 p.m.
Fri., Dec. 5	8:00 p.m to 3:00 p.m.

Fees for Nonmembers

A registration fee of $5 will be charged nonmembers attending the 1952 Annual Meeting of The American Society of Mechanical Engineers. The fee for student nonmembers will be $1.

The following nonmembers will be exempt from the payment of the registration fee:

Immediate family of a member (any grade)
Authors listed in the program or their appointed representatives
Invited discussers
Session chairmen and vice-chairmen
Committeemen required to attend a meeting of their committee
Session aides
Members of the Woman's Auxiliary to the ASME
Members of The Engineering Institute of Canada
Members of societies listed in the program
Distinguished guests invited by the President or Secretary of the Society

Members and Students Luncheon

This is a perennial favorite. This luncheon is attended by many "first" members—first annual meeting, first year at college, and first award. At this luncheon two awards are made—the Charles T. Main Award which this year will go to I. E. Rubin and the Undergraduate Student Award, to G. L. Stocking.

At the McAlpin Hotel

The American Rocket Society, which is an affiliate of ASME, is recognized as the leading American technical group in the rocket industry. ARS meetings, session, and meals will be held in the McAlpin Hotel ballroom and Winter Garden. Registration will be on the 24th floor. There are five sessions planned starting Wednesday afternoon and continuing through Friday afternoon; the program includes the annual Honors Dinner on Thursday, at which time the pioneers and men who have helped develop the rocket will be honored; at the luncheon on Friday, Wernher von Braun, of Redstone Arsenal, Huntsville, Ala., will speak on The Importance of Satellite Vehicles in Interplanetary flight.

The Applied Mechanics sessions will be held at the McAlpin on the mezzanine and the Applied Mechanics sessions program preceding and during the Annual Meeting will be in cooperation with the Society for Experimental Stress Analysis, which will be meeting at the McAlpin from Dec. 3 to 5, 1952.

Social Events

The social events of the Annual Meeting start with a reception at the Engineering Woman's Club on Sunday afternoon. The

luncheons during the meeting starting with Monday are the President's Luncheon. R. J. S. Pigott will speak on the ASME and the Engineer. Tuesday, the Heat Transfer luncheon. On Wednesday there are three luncheons: A. H. Williams will speak on Business Leadership in a Democracy at the Roy V. Wright Luncheon and Lecture. Gerald Piel will speak on Control and Communication at the IIRD luncheon, and F. O. Hess will speak on Fuels in a Technical Economy at the Fuels luncheon. The program for Thursday includes the Members and Students Luncheon and the noon gathering of the Wood Industries Division. On Friday the Textile Engineering Division will have as its luncheon speaker Douglas Williams who will talk about employees' attitudes and productivity.

College Reunions

The ASME Annual Meeting is traditionally the time for college reunions because so many engineers gather here to attend the technical sessions. To date the following schools have announced their intentions to hold reunions: The University of California, Carnegie Institute of Technology, Cooper Union, Cornell University, Georgia Institute of Technology, The Johns Hopkins University, the University of Michigan, the University of Missouri, Rensselaer Polytechnic Institute, and Stevens Institute of Technology.

Inspection Trips

At present the tentative list of inspection trips includes visits to Lever Brothers Building, Park Avenue, New York, N. Y.; American Airlines Shops, La Guardia Field, N. Y.; United States Rubber Company, Passaic, N. J.; International Smelting and Refining Company, Perth Amboy, N. J.; and Westinghouse Electric Company, Lamp Division, Bloomfield, N. J. There will, no doubt, be several other places of interest selected for visits before meeting time.

Women's Program

A program—if New York City is not enough—has been arranged to entertain the guests attending the meeting. The program follows:

Sunday: Nov. 30, 3:00–6:00 p.m., a reception at the Engineering Woman's club.

Monday: Dec. 1, 4:00–7:00 p.m., a tea dance at the Statler Hotel.

Tuesday: Dec. 2, 9:00 a.m., breakfast at B. Altman's. 12:00 noon, luncheon at the Beekman Hotel and UN tour. 9:00 p.m., Coffee Hour and travel film, "A Dream and a Memory." This is a 30-minute sound and color film which shows what one may enjoy on a trip to the Territory of Hawaii. A similar trip to Hawaii is being planned in conjunction with the 1953 Semi-Annual Meeting to be held in Los Angeles, June 28 to July 2, 1953. The tour will start the evening of July 2 via airplane and return on the SS *Lurline* on July 23rd, after spending fifteen days of delightful sight seeing at Hawaii and five restful days on the returning steamer. This is being planned as an all-expense trip with a pleasant ASME group.

Wednesday: Dec. 3, 9:00 a.m., Presidents' Breakfast at the Statler Hotel; 10:30 a.m., Annual Business Meeting of Woman's Auxiliary, ASME; 12:30 p.m., annual luncheon and fashion show at the Pierre Hotel.

Thursday: 10:30 a.m., inspection trip to *SS America* and buffet luncheon at the Town Hall Club.

Official Notice

ASME Business Meeting

THE annual business meeting of the members of The American Society of Mechanical Engineers will be held on Monday, Dec. 1, 1952, at 5:00 p.m., at the Hotel Statler, New York, N. Y., as a part of the Annual Meeting of the Society.

Members are urged to attend.

Twentieth National Power Show Covers Applications in Every Industry

EVERY going industry is included in the scope of the Twentieth National Exposition of Power and Mechanical Engineering which will be held in Grand Central Palace, New York, N. Y., Dec. 1–6, 1952, under the auspices of The American Society of Mechanical Engineers. The event coincides with the ASME Annual Meeting, at the Statler Hotel, Nov. 30–Dec. 5, and many of the exhibits at the show will exemplify subjects under discussion by the engineers.

The exposition covers all branches of the field of power from the conversion of energy into fluid forms, such as heat, light, flowing water, and steam, as well as hot, cold, and compressed air, to its application in moving mechanisms. It includes the conversion processes themselves, such as the combustion of fuels, generation of electricity, and the operation of heat exchangers, pumps, and blowers; distribution in transmission lines and pipe lines, and it includes all the many applications within the industrial plant, through wires, piping, shafting, and belts, whether or not it generates its own power or buys it from a public utility.

Attendance is limited to persons having a professional, scientific, or personal interest in the exhibits. Visitors are admitted by invitation and registration, but without registration fee, while the general public is excluded.

Exhibitors numbering more than 300 will occupy three floors of the Palace to the last available space. Many are specialists who confine themselves to a single type of product, though that may be shown in a range of sizes and patterns adapted to different applications. Others will stage displays incorporating a dozen or more different associated products.

Major exhibit classifications include: Power-plant equipment; power-transmission equipment; electrical, heating and ventilating, and air-conditioning equipment; also materials-handling equipment, safety, building construction, plant maintenance, and equipment for research and testing. The classified list includes 350 items ranging from abrasives, acid-resisting materials, and accumulators, through boilers, condensers, drives, driers, and ducts to winches, woodworking machinery, and wrenches.

New ASME Officers Elected by Letter Ballot

AS reported by the tellers of election, 1953 officers, F. E. Lyford, A. R. Mumford, and H. B. Reynolds, letter ballots received from members of The American Society of Mechanical Engineers, were counted on Sept. 23, 1952. The total number of ballots cast was 11,257; of these 260 were thrown out as defective.

	Votes for	*Votes against*
For President		
Frederick Steele Blackall, jr	10,964	33
For Regional Vice-Presidents —serve two years		
Henry Reginald Kessler	10,973	24
Paul R. Yopp	10,971	26
Ben George Elliott	10,976	21
Harry Randall Pearson	10,973	24
For Directors at Large— serve four years		
David William Rowsen Morgan	10,977	20
Ralph Leon Goetzenberger	10,974	23

The new officers will be introduced and installed in office during the 1952 Annual Meeting of the Society to be held at the Hotel Statler, New York, N. Y., Nov. 30–Dec. 5, 1952.

Biographical sketches of the newly elected officers were published in the August, 1952, issue of MECHANICAL ENGINEERING, pages 688–691.

ASME Membership as of September 30, 1952

Honorary Members	54
Fellows	380
Members	13,429
Associates	352
Juniors (33 and over)	3,207
Juniors (30–32)	1,876
Juniors (To the age of 29)	18,147
Total	37,445

ASME Joins in Centennial Celebration

Fall Meeting Attracts More Than 1200 Mechanical Engineers

THIS year's ASME Fall Meeting, held in conjunction with the Centennial of Engineering, marking the 100th anniversary of the founding of the American Society of Civil Engineers, took place in the Sheraton Hotel, Chicago, Ill., September 7 to 11. Joining with the more than 60 other engineering organizations who participated in the Centennial in Chicago, ASME through its Chicago Section, arranged and scheduled a noteworthy program as its contribution to this memorable occasion.

Besides the impressive and revealing technical presentations, numerous functions such as the International Presidents' Luncheon at which presidents of engineering societies from other countries were honored, the ASME Calvin W. Rice Lecture, the Roy V. Wright Luncheon and Lecture, ASME participation in the Centennial Pageant and in the Centennial Day Luncheon and Evening Party, reflected the imposing part played by the engineering profession, combined with industrial enterprise and sound management, in offering to the world a better way of life. Included among the array of speakers heard were the Hon. Ralph E. Flanders, U. S. Senator from Vermont, former President Herbert Hoover, and Charles F. Kettering.

The meeting got under way on Sunday, September 7, with a two-hour sight-seeing drive north along the shore of Lake Michigan. The drive was arranged by the Chicago Section which supplied cars for out-of-town ASME members, guests, and their ladies. An excellent shore-line view of Chicago was provided during the drive which ended with a reception and refreshments at the Edgewater Beach Hotel, compliments of the Chicago Section. The much-enjoyed trip was rounded out with a dinner, dancing, and a floor show in the Marine Dining Room of the hotel.

International Presidents' Luncheon

Dignitaries representing various engineering bodies of some twenty foreign nations made Monday's luncheon a truly international one. In addition, ten U. S. engineering societies participated in the program.

James D. Cunningham, a past-president and Fellow of ASME, welcomed ASME members and guests to Chicago. C. E. Davies, secretary ASME, then called the roll of presidents of the following American engineering societies who were present: Boston Society of Civil Engineers, American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Institute of Electrical Engineers, American Institute of Chemical Engineers, Engineers Joint Council, American Society of Heating and Ventilating Engineers, Society of Automotive Engineers, American Society of Refrigerating Engineers, and Western Society of Engineers. Also called upon were representatives of engineering groups from the following countries: Argentina, Australia, Belgium, Brazil, Canada, Chile, Columbia, Cuba, Denmark, Dominican Republic, France, Great Britain, Italy, Netherlands, Norway, Panama, Paraguay, and Uruguay.

Special responses were made by Dr. Luis Giannattasio, president, Pan-American Federation of Engineering Societies (UPADI), Montevideo, Uruguay, on behalf of the Latin-American countries; and by Sir David Pye, president, The Institution of Mechanical Engineers, London, England, for the European representatives. Dr. Giannattasio congratulated America on its progress in engineering, while Sir David paid tribute to the constant co-operation and relations carried on, for example, between the ASME and IME, citing the organization of joint meetings on subjects of common interest to mechanical engineers such as lubrication, heat transfer, and the like.

CHICAGOANS GREET GUESTS

(James D. Cunningham, past-president, ASME, who welcomed ASME members, guests, and representatives of foreign engineering societies, is shown with Ovid W. Eshbach, *right*, president, Western Society of Engineers, who presided at the International Presidents' Luncheon.)

Mr. Pigott Principal Speaker

The principal address at the luncheon was given by R. J. S. Pigott, President and Fellow of ASME. Speaking on the subject, "What Is Not Yet, May Be," Mr. Pigott indicated that the current trend to large-size high-temperature, high-pressure steam turbines have just about hit their peak and probably won't get much larger in the near future. As for gas turbines, he said, they are not yet ready to replace reciprocating engines in most cases, such as in buses, trucks, and automobiles. However, in aviation, for long and fast flights, they may prove commercially acceptable on a large scale in the future.

Mr. Pigott declared that he cannot get too excited over the possibility of obtaining useful power from the atom. The whole field of atomic power is still too new and is nowhere near a state of maturity, he said. The uranium supply is also too low at present to predict any extensive use for power purposes. He said it might take anywhere from 30 to 100 years before useful atomic power on a large scale will be realized. Radioactivity, he pointed out, is also a big problem.

Touching on the fuels problem, fossil and synthetic, he said, that various fuels' sources are diminishing rapidly. Perhaps, in the future we may have to go to large-scale production of sun power, tide power, and wind power, if efficient means of harnessing these types of power can be found.

In production he cited the use of powder metallurgy, new improved metal-cutting tech-

VIEW OF HEAD TABLE DURING INTERNATIONAL PRESIDENTS' LUNCHEON

AT THE INTERNATIONAL PRESIDENTS' LUNCHEON ON MONDAY
(*Left to right:* Sir David Pye, president, IME; R. J. S. Pigott, president, ASME; and Luis Giannattasio, president, UPADI.)

niques, cold welding, and the like, as a means for producing better and cheaper products in the future.

Centennial Ceremonies

Centennial ceremonies were also a part of the program. Scrolls honoring the 100th birthday of ASCE were accepted by Carleton S. Proctor, president of ASCE, from President Pigott on behalf of ASME and from Ernest Szekely for the ASHVE.

In addition, 50-year ASME membership buttons were presented to Charles D. Terry and Fred A. Krehbiel.

Ovid W. Eshbach, president, Western Society of Engineers, presided at the luncheon.

Management Dinner

At the Management Dinner on Monday evening, ASME members and guests heard Ruy Miller de Paiva, who represented the president of the Brazilian Institute of Management (IDORT), pay tribute and offer greetings on behalf of the Institute to the ASCE on their 100th anniversary. He also extended a warm invitation to the engineers of the United States to attend the Tenth International Management Congress to be held in Sao Paulo, Brazil, in 1954. CIOS, he pointed out, organizes an international congress every four years in different member countries, in order to stimulate the exchange of knowledge and experience of scientific management and to diffuse the application of their methods among businessmen.

Also addressing the dinner group, Dr. Hugo de Haan, secretary general of CIOS, said that the Western Hemisphere Management Conference, presented during the ASME Fall Meeting, appears as a by-product, or better, as an offspring of the American Engineering Centennial—just as its organizing body, the Management Division of ASME, is a management offspring of The American Society of Mechanical Engineers.

This Management Conference, he said, held during an engineering centennial, appears therefore to be a tangible proof of the closely interwoven relationship between engineering and management, a relationship which explains why in many of our CIOS countries the management movement originated in the engineering societies, a relationship which produced the modern combined profession of the "management engineer," who embodies the happy alliance between engineering and management.

Dr. de Haan then gave a short historical review of the management movement as a whole, on the national American level, as well as on the international level.

Harold F. Smiddy, vice-president of the National Management Council, presided.

Gas-Turbine-Power Luncheon

The story of gas-turbine engineering and of engineering in general can be distinguished by three typical epochs, Claude Seippel, director of research, Brown Boveri Company, Baden, Switzerland, told ASME members and guests in attendance at Tuesday's Gas-Turbine-Power Luncheon. Speaking on the subject, "Gas Turbines in Our Century," he said that the first occurred around 1900 and was the epoch of great inventors, of men acting by intuition more than by reasoning and imputation. They created an almost perfect Diesel engine and a fair steam turbine, but no gas turbine worthy of the name. The second, he declared, was the epoch of more precise theoretical thinking to assist intuition. It saw the growth of steam turbines to 100 mw and more, and produced the first working gas turbines. The third epoch, the present, he said, is a period of systematic experimenting to support theoretical thinking which in turn guides intuitive action. It is the epoch of wind tunnels, of metallurgical laboratories, of research in combustion, of physicists and chemists. We have learned to observe nature, to interpret her teachings, and translate them into practical constructions, he said. The gas turbine is a very pretentious machine, Dr. Seippel pointed out, which, unlike the combustion engine and the steam turbine, had to wait the advent of the third epoch before it could be made a success.

John T. Rettaliata, president, Illinois Institute of Technology, Technology Center, Chicago, Ill., presided.

Centennial Pageant

Tuesday evening was devoted to participation by ASME members and guests in the Centennial Pageant. This included a tour of the Museum of Science and Industry, which in its 14 acres of floor space, is devoted to the scientific and industrial achievements of America and the human stories behind the test tubes and machines. An ASME dinner at the Museum followed.

In the evening, those in attendance saw a special ASME performance of the Centennial Pageant, "Adam to Atom." Starting with primitive man and his conquest of fire, this musical extravaganza vividly depicts such historical events as the first tools, discovery of the wheel, building of the pyramids, Gutenberg's printing press, Watt's steam engine, Whitney's interchangeable musket parts, Howe's sewing machine, the first meeting of the American Society of Civil Engineers, Morse's and Bell's work with the telegraph and telephone, Edison's phonograph, Ford's mass-produced autos, motion pictures, and so on, to the present-day atomic age.

In the 25 scenes presented, the revue portrayed effectively the work of the engineer down through the ages. The scenery, settings, and musical numbers, particularly the ballad of the engineer where a balladier sings of technological wonders as he moves across the country, and the festival during the building of the Panama Canal when President Theodore Roosevelt toured and inspected the locks, were gay and colorful.

ROY V. WRIGHT LECTURE BEING GIVEN BY THE HON. RALPH E. FLANDERS

Roy V. Wright Luncheon and Lecture

In presenting the Roy V. Wright Lecture, "Engineering and Politics," at a luncheon on Thursday, the Honorable Ralph E. Flanders, United States Senator from Vermont, told ASME members and guests that science and engineering have brought to the world problems at least as grea- as the problems they have solved. It is suggested that these inventions and developments have come faster than we can assimilate them. There have even been proposals made for setting up a moratorium on science and engineering while we catch up with the social problems involved in digesting the changes already made.

Another and seemingly more practical suggestion has been that the engineer apply his experience and abilities to the solving of the social problems which his work has created. The assumption is that the social problems have enough similarity to the physical ones to give a reasonable hope that success may be had in the social field similar to that which has been reached in the physical one.

There is an engineering approach to these problems. The engineer has an objective. He studies and analyzes the materials with which he has to deal. He acquaints himself with the natural forces which he cannot change, which are more powerful than he is but to which he must adapt himself so that he may make use of them.

Senator Flanders proposed such a specific objective—the task of ending the war in Korea.

He said that we are immediately concerned with the Chinese communists, the people of North Korea, and the people of South Korea. Taking first the Chinese communists, they have expressed no other interest or purpose in this war than the safeguarding of the border of Manchuria against invasion. Could some guarantee be given them against this danger, they could not proceed with the war without stultifying themselves and they could cease the conflict without losing face, which is an important consideration with Oriental peoples.

The proposals made to communist China could be the neutrality of the Yalu watershed in Northwest Korea. This territory is sparsely populated, and valuable largely only as a supply of hydroelectric power. We would propose, said the Senator, that its military neutrality be inspected and administered by a commission from completely Asiatic peoples. Pakistan, India, Ceylon, the Philippines could engage in this undertaking of Asia for the Asiatics. No white peoples, no capitalistic nation, no colonizing empires would be permitted on this commission. This has in it elements of appeal to the communist Chinese government and would strike new respect throughout Asia of usefulness and confidence in United Nations procedure and particularly in the position in Asia of the United States. It could mean a revolution in Asiatic thought toward us and a revolution is long overdue.

We would rain peace offers on the armies of communist China and on the people of North Korea. We would assure the armies of communist Chinese that all the interests of their government would be protected. We would urge them to cease combat and to retire. We would do this the more confidently, since we know that 100,000 of the 170,000 war prisoners do not wish to be returned. They have lost sympathy with the plans and the policies which sent them into this bloody conflict.

On the people of North Korea we would rain from the air peace offers of rebuilding industry, transportation, and housing. We could well afford to do this if the people were in a mood to surrender. It is costing us around $6 billion a year to carry on this war. Six-billion dollars in reconstruction would go a long way, he said.

We would offer this reconstruction to a united North and South Korea. The inhabitants of neither section can enjoy a prosperous peace separated. The industrial north and the agricultural south must be brought together. When brought together they can enjoy as a practically self-contained economy, a standard of living that is higher than is available to any considerable area anywhere else in the whole continent of Asia.

The Chinese communist government, the Chinese communist armies, the people of North Korea, and the people of South Korea all have a stake in a peace proposal of this sort.

In making a proposal of this kind, Senator Flanders stated, we have behind us the spiritual forces of the universe. We are not trying to use these people as tools for our own interest. We are in a real and effective sense loving our Korean neighbors as ourselves.

This engineering approach to one of our large problems sets up a human objective, makes use for their own benefit of human materials, and employs the spiritual forces of the universe.

ASME president R. J. S. Pigott presided at the luncheon.

ASME Calvin W. Rice Lecture

The debt which students of business management throughout the world owe to the engineering profession in the United States was the theme of this year's Calvin W. Rice Lecture. The lecture honors Mr. Rice who served as secretary of ASME from 1906 to 1934, devoting his life to increasing understanding between engineers of the world.

Speaking on the subject, "Management's Debt to Engineers," Colonel Lyndall F. Urwick of London, England, the Rice Lecturer, singled out such people as Taylor, Gantt, and the Gilbreths, all ASME members, whose names were conspicuous in the early days of the scientific-management movement. He suggested, however, that the contribution of these individuals as inventors and initiators was less important than the fact that they focused and organized tendencies in human thought which were already in the atmosphere when they started on the work of their lives. The ASME, Colonel Urwick said, placed all of us in their debt when the Society gave them a ready platform for management concepts. F. W. Taylor presented four papers to the Society on such subjects and was its president; H. L. Gantt, 11 such papers; F. B. Gilbreth, 4; and Lillian Gilbreth, 8 up to 1949.

COLONEL LYNDALL F. URWICK DELIVERING THE ASME CALVIN W. RICE LECTURE

But, said Colonel Urwick, the American engineering profession rendered the world and its future an even greater service by providing a climate of professional opinion by which extracurricular ideas could take root and germinate. He emphasized that it is this breadth of vision, this determination not to confine their interests within too narrow technical bounds, for which the world owes that profession its undying gratitude.

Technical Program

The technical program scheduled by ASME during the Centennial included some 80 papers presented at 33 sessions and covered engineering progress in various fields, present-day developments, and future trends in engineering.

Wide Variety of Material Presented

A symposium on tolerances and specifications of castings was featured in metals engineering. Covered were the statistical aspects of specifications; and tolerances and specifications for aluminum and magnesium castings, precision investment castings, gray-iron castings, permanent-mold gray-iron castings, steel castings, and malleable castings.

Another feature was the Western Hemisphere Management Conference presented under the auspices of the International Committee of Scientific Management (CIOS) with the Brazilian Institute of Management (IDORT), The Canadian Management Council, and the U. S. A. National Management Council participating under the administration of the ASME Management Division. Such subjects as human aspects of industrial engineering, management talent for industrial expansion, and a round-table discussion on management development in the Western Hemisphere were included.

For the first time a gas-turbine progress report was programmed embodying gas-turbine materials, cooling, and fuels; thermodynamics; and gas-turbine progress in the automotive, locomotive, aviation, marine, merchant vessel, naval vessel, and central-station fields, including specialized industrial applications.

The two sessions on Wood Industries listed on the ASME program were also part of the Wood Symposium presented during the Centennial of Engineering. Papers

AT THE ROY V. WRIGHT LUNCHEON AND LECTURE
(*Left to right:* Eugene O'Brien, R. M. Gates, and Dean A. A. Potter, all past-presidents of ASME.)

covered subjects on plywood, woodworking-machinery history (1852–1952), a century of progress in the production of furniture, a brief history of American forest products, wood-cutting-tool developments, wood preservation, and wood-waste products.

Among the many other papers presented at the meeting the following subjects give a good cross section of the variety and scope of material covered: Small-plant safety, trends in aircraft rubber requirements, synthetic-fuels development, Diesel-engine manufacture, contour machining, outdoor steam power stations, pressure-operated pulverized-coal-fired boilers, features of water tunnels for hydraulic investigations, and gas-turbine controls. In addition there were numerous papers in the fields of machine design, applied mechanics, fuels, heat transfer, and materials handling.

Nuclear-Energy Applications

Of great interest and importance to engineers at the present time is the field of nuclear energy. In a paper, "Industrial Applications of Nuclear Energy," Alfonso Tammaro, manager of the Chicago Operations Office of the Atomic Energy Commission, pointed out that one of the most important potential uses is the production of power with a reactor heat source.

Well under way at this time is a large program whose objective is to utilize this heat source in power plants for ship propulsion. The power requirements of ships and of naval vessels, in particular, are high. A large carrier, for example, may well have a propulsion plant capable of producing over 200,000 kw. So the progress made in this program can be expected to contribute greatly to the technology of power-producing reactors in general.

The nuclear ship-propulsion program, which is being carried forward jointly by the Navy and the Atomic Energy Commission, consists of the naval submarine program and the naval large ship reactor program.

Perhaps of more interest to landlocked engineers, Mr. Tammaro said, is the Experimental Breeder Reactor which has been in operation since August, 1951. This reactor is farther advanced than any of the other power reactors, and has already demonstrated the production of electric power.

Visualize if you can, he said, a conventional power plant that not only burns coal to ashes but also creates fuel in the process. Further, more of this fuel so created, would be produced, than the coal burned. This is, in effect, what is possible in a breeding reactor, and the EBR is now being studied to determine how much fuel can be produced in excess of the quantity burned. In addition to this phenomenon, this reactor is generating electric power.

The EBR began operation in August, 1951. On Dec. 20, 1951, the world's first production of significant amounts of electricity from a nuclear-reactor heat source was achieved when four bulbs were lighted. The following day the external electric supply to the building was disconnected and the entire power load was carried by the reactor-boiler-turbine-generator system. This included all electric lighting, electric power requirements for all auxiliary equipment such as pumps, fans, etc., and the power requirements for the machine shop.

ENJOYING A CHAT DURING GAS-TURBINE POWER LUNCHEON ARE (*right*) CLAUDE SEIPPEL, THE SPEAKER, AND J. T. RETTALIATA, VICE-PRESIDENT, ASME REGION VI, WHO PRESIDED)

The problem now is to generate this power economically and, as a part of the program, to study ways of doing this economically, four teams of industrial organizations have been making economic and engineering studies of nuclear-power production for the past year. This has been done at their own expense.

On the basis of their findings, some of these organizations have already expressed interest in proceeding further with investments of their own funds.

A number of the ASME Fall Meeting papers are scheduled for publication in either MECHANICAL ENGINEERING, Transactions of the ASME, or the *Journal of Applied Mechanics*. Digests of available Fall Meeting preprints appear on pages 919–928 of this issue.

American Rocket Society

The American Rocket Society, an affiliate of ASME, also scheduled three technical sessions during the meeting. Papers covering upper-atmosphere research, the high-altitude sounding rocket, the satellite vehicle, manned flight at the borders of space, ramjets, pulse-jets, liquid-propellant rocket systems and the like, were presented.

Women's Program

A well-rounded program of interesting events was scheduled for the entertainment of the women at the meeting. On Sunday, September 7, the women joined the men in the sight-seeing trip along Lake Shore Drive and the dinner at the Edgewater Beach Hotel. The next day, Monday, the women enjoyed a Smörgasbord Luncheon at the Küngsholm Restaurant. This was followed by a performance of the world-famous Puppet Opera. A tour of the stockyards and packingtown of the Armour Packing Company was on Tuesday's schedule, including a luncheon, a talk, and movies. Later the women joined the men in a tour of the Museum of Science and Industry and a dinner at the Museum. That night they attended a special ASME performance of the Centennial Pageant, "Adam to Atom." On Wednesday afternoon the women enjoyed a combination card party and style show at the headquarters hotel. Completing the program were sight-seeing tours of Marshall Field and Company and the Art Institute on Thursday and a tour of the Chicago Natural History Museum on Friday.

Committees

The many committee members whose hard work and careful planning helped make the meeting a success included the following: *Meetings*, R. H. Bacon, chairman, Jess H. Davis, Roland W. Flynn, B. H. Jennings, J. K. Louden, A. W. Thorson, Thomas A. Marshall, Jr., Glenn R. Fryling, and Harvey D. Moll; *General*, B. H. Jennings, chairman, H. A. Erickson, vice-chairman, and E. C. Bailey, vice-chairman; *Finance*, D. J. Bergman, chairman, F. D. Cotterman, and C. W. Parsons; *Hospitality*, A. B. Openshaw, chairman, E. F. Obert, and G. A. Becker; *Hotel*, W. E. Walsh, chairman, L. A. Evers, and J. W. Barnett,

Inspection Trips, W. H. Pletta, chairman, Carl Norlander, and M. B. Chalfen; *Publicity*, S. I. Cole, chairman, J. P. Hertz, and O. A. Rothchild; *Reception*, F. A. Faville, chairman, R. K. Behr, and F. J. Hamilton; *Registration*, Alf Kolflat, chairman, A. J. Snider, and R. W. Helbig; *Student Group*, S. E. Rusinoff, chairman, J. S. Kozacka, and W. L. Rogers; *Technical*, R. S. Hartenberg, chairman, J. M. Roehm, and Everett Weston; *Women's Activities*, Mrs. W. E. Walsh, chairman, Mrs. W. H. Oldacre, and Mrs. E. C. Bailey.

ASME Boiler Code Committee Honored by American Standards Association

DURING the Centennial of Engineering celebration recently held in Chicago, Ill., engineers from all over the world gathered to review and pay tribute to the achievements of the past one hundred years in engineering, evaluate present accomplishments, and in some cases to predict future possibilities. All of this inventory gave rise to the presentation of honors.

The American Standards Association's regular morning session, September 9, held at the Museum of Science and Industry, was interrupted to honor the work of the Boiler Code Committee of The American Society of Mechanical Engineers. Roger E. Gay, president of ASA, introduced Dr. A. M. Greene, Jr., Hon. Mem. ASME, dean emeritus, school of engineering, Princeton University, who delivered a talk on the history and development of the ASME Boiler Code Committee. (The first chapter of Dr. Greene's history of the Committee was published in the July, 1952, issue of MECHANICAL ENGINEERING.)

Telling of the Committee since 1911, Dr. Greene said, "In all of the work of the Boiler Code Committee, co-operation and safety have been two of its most cherished considerations in reaching decisions. It has consulted freely and used the aid of other organizations and has been willing to have others use its work. . . ." "It points to the low record of serious boiler explosions since 1916 even with the great increase in the number of boilers, many of them of enormous size."

R. J. S. Pigott, president of ASME, and H. B. Oatley, Fellow ASME and chairman of the Boiler Code Committee, were called on to receive a scroll which was read by Mr. Gay. The citation reads as follows: "The American Standards Association presents this certificate honoring the Boiler Code Committee of The American Society of Mechanical Engineers, devoted and faithful servant for more than forty years in the cause of protecting life and property through the advancement of the design, performance, and safety of steam boilers and other pressure vessels. For its unstinting guidance to those seeking counsel, its contributions to the establishment of sound state and municipal legislation, and its national and international leadership in promoting standards in the public interest. September 9, 1952. Signed by Roger E. Gay, president; John R. Townsend, chairman, Standards Council; and G. F. Hussey, Jr., managing director."

Mr. Gay presented the scroll to Mr. Pigott who turned it over to Mr. Oatley on behalf of the Committee, who on accepting it said, ". . . this was a wonderful gesture on the part of ASA and the scroll should become the property of the Society." On September 19, at a meeting of the Executive Committee of the Boiler Code Committee the scroll was officially accepted by C. E. Davies, secretary of ASME, for the Society.

PRESENTATION OF SCROLL TO ASME BOILER CODE COMMITTEE BY AMERICAN STANDARDS ASSOCIATION STANDARDS COUNCIL

(*Left to right:* H. B. Oatley, consulting engineer, Combustion Engineering-Superheater, Inc., and chairman of Boiler Code Committee: R. J. S. Pigott, president, ASME: and Roger E. Gay, president, ASA.)

Council of Engineering Societies Secretaries Holds Meeting in Chicago

THE Council of Engineering Societies Secretaries held its sixteenth annual meeting at The Hotel Sheraton during the Centennial of Engineering in Chicago, Ill. The meeting was held Sept. 12-13, 1952. This organization is composed of secretaries of local, state, and national engineering societies and members of their staff.

The purpose of the meeting, in addition to furthering the acquaintance which exists between the secretaries from various parts of the country, is to avail the secretaries of an opportunity to exchange ideas regarding the management and operation of engineering organizations.

There is a nominal fee for membership in this organization which is used to defray the expenses of producing the printed copies of the program and minutes and their mailing.

The program for the meeting at Chicago was highlighted by talks and round-table discussions on subjects such as Tax Problems; Engineering Manpower, by T. A. Marshall, Jr., Mem. ASME, executive secretary EJC Engineering Manpower Commission; An Engineering Societies Library, by Ralph H. Phelps, director, Engineering Societies Library, New York, N. Y.; Unity, by Titus G. LeClair, vice-president, Commonwealth Edison Company, Chicago, Ill.; Raising Funds for An Engineering Society or Club, by R. H. Bacon, Mem. ASME, president, R. H. Bacon & Company, Chicago, Ill.; Engineers' Council for Professional Development and Their Training Program, by Cornelius Wandmacher, professor of civil engineering, University of Cincinnati; How to Plan For a Committee Meeting or Conference, Relations Between Local and National Engineering Societies, by O. Laurence Angevine, secretary, Rochester Engineering Society; and Engineering Societies Personnel Service—And How to Keep Engineers Employed Through Its Branch Offices, by Alfred H. Meyer, director, Engineering Societies Personnel Service, discussion led by Earl Harrington, secretary, Western Society of Engineers, Chicago, Ill.

The Council of Engineering Societies Secretaries accepted the invitation of the Engineers' Club of Philadelphia to hold its 1953 meeting at Philadelphia on Friday and Saturday, June 5-6.

The officers elected for the coming year are: President, Henry S. Harris; Mem. ASME, Engineers' Club of Philadelphia, Philadelphia,

Pa.; vice-president, Ernest Hartford, executive assistant secretary, ASME, New York, N. Y.; secretary, Frank G. Horton, The Engineering Society of Detroit, Detroit, Mich.; treasurer, M. C. Turpin, The American Society of Refrigerating Engineers, New York, N. Y.; director for one year, Edward H. Robie, The American Institute of Mining and Metallurgical Engineers, New York, N. Y.; director for two years, Henry H. Henline, American Institute of Electrical Engineers, New York, N. Y.; director for three years, J. Earl Harrington, Western Society of Engineers, Chicago, Ill.; and director for one year, Col. William N. Carey, American Society of Civil Engineers, New York, N. Y.

ECPD Stresses Action

Progress Made at Twentieth Annual Meeting, Chicago, Ill., Sept. 5-6

THE twentieth Annual Meeting of Engineers' Council for Professional Development, held at the Sheraton Hotel, Chicago, Ill., Sept. 5 and 6, 1952, was a notable event from several points of view.

Notable Features

Change of the date of the meeting from late October to early September was made in order to take advantage of the Centennial of Engineering, held in Chicago from Sept. 3 to 13, to commemorate the one hundredth anniversary of one of ECPD's constituent organizations, the American Society of Civil Engineers.

Moreover, the meeting was the first to be held by ECPD in conjunction with another of its constituent organizations, the American Society for Engineering Education. In view of the fact that, during the past year, the Education Committee had co-operated with the Committee on Adequacy and Standards in Engineering Education in promoting the establishment of a committee in ASEE for the evaluation of engineering education, this joint meeting afforded not only opportunity to advance the progress of the new committee but also to hold a joint session with the Engineering College Administrative Council of ASEE devoted to a discussion of contemporary demands on engineering curricula.

The twentieth annual meeting was noteworthy also because of the election of L. F. Grant, field secretary, The Engineering Institute of Canada, as chairman, ECPD, the first representative of EIC to fill that important post of leadership in ECPD.

The meeting also marked the termination of the three-year term of service of Harry S. Rogers as chairman of ECPD. Throughout his career as chairman, Dr. Rogers neglected no opportunity offered to him to express, in lucid and convincing language, the philosophy animating ECPD's function and programs. Not only did he make himself clear on these points to ECPD, but also to other joint organizations of the engineering societies and to the societies themselves. His concept of the nature of ECPD as an intersociety, intraprofessional undertaking has been clarifying and helpful. His logically reasoned and eloquently expressed views have communicated enthusiasm and clear thinking about ECPD to members of the Council and its friends. Significant as these achievements are they are overshadowed by the success which has attended his efforts to examine and reorient the objectives and programs of ECPD Committees. In phrases he has repeatedly used, he led ECPD from the "talk-about" into the "action" phases of its work, thereby getting some portions of its program "off dead center."

Initiation of Training Program Announced

The culminating and perhaps the most important of Dr. Rogers' action program and also the most noteworthy event of the twentieth annual meeting was the announcement that the program of the Training Committee, "The First Five Years of Professional Development," originally proposed two years ago at the Cleveland meeting, is to be initiated in Cincinnati, Ohio, during the coming year under exceptionally favorable conditions.

Officers Elected

At the administrative session of the Council, held on the morning of September 5, L. F. Grant was elected chairman. Other officers elected were: vice-chairman, H. T. Heald, chancellor of New York University; secretary, C. E. Davies, secretary ASME; and assistant secretary, H. H. Henline, secretary AIEE. The Executive Committee of the Council will consist of the foregoing officers and H. S. Rogers (ASCE), C. E. Lawall (AIME), Guy R. Cowing (ASME), M. D. Hooven (AIEE), E. V. Buchanan (EIC), Webster N. Jones (AIChE), Thorndike Saville (ASEE), and C. S. Crouse (NCSBEE). Chairmen of the standing committees were elected as follows: Guidance, B. G. A. Skrotski; Education, Thorndike Saville; Training, Cornelius Wandmacher; Recognition, R. H. Barclay; Information, George A. Stetson; and Ethics, William F. Ryan. (A. C. Monteith was elected honorary chairman of the Training Committee at the Saturday session, in recognition of his leadership in formulating the program of that committee.)

Representatives of ASME on ECPD are: William F. Ryan, vice-president, Stone and Webster Engineering Corporation, Boston, Mass., whose first term expired in 1952; A. C. Monteith, vice-president in charge of engineering and research, Westinghouse Electric Corporation, Pittsburgh, Pa., whose first term expires in 1953; and Guy R. Cowing, president and director, General Motors Institute, Flint, Mich., whose second term expires in 1954. Mr. Ryan has been appointed an ASME representative for a second term of three years.

A budget of estimated income and expenditures for 1952-1953 of $16,450 was adopted. Of this income, $10,050 comes in the form of grants from the participating societies. The ASME grant, which is based on its dues income as of Sept. 30, 1951, is $2045.

It was announced that the twenty-first annual meeting of ECPD will be held at the Statler Hotel, New York, N. Y., Oct. 30-31, 1953.

Luncheon With ASEE

At the luncheon on Friday, held jointly with ASEE, W. R. Woolrich, president ASEE, presided. The address was delivered by John Millett, director, Commission on Financing Higher Education, Columbia University. Dr. Millett said that while the financing of engineering education had not been a very serious problem in the past, it would become increasingly difficult to provide funds in the future.

Session on Curricula

The session on Friday afternoon was held jointly with the Engineering College Administrative Council of ASEE and ECPD. Under the chairmanship of J. H. Lampe, dean of engineering, North Carolina State College, an ECPD-ECAC Panel had been organized to discuss the topic "1920-1950; What Are Contemporary Demands on Engineering Curric-

SHOWN AT THE ECPD ANNUAL DINNER, *left to right*, ARE: H. S. ROGERS, MEM. ASME, PRESIDENT, POLYTECHNIC INSTITUTE OF BROOKLYN, AND PAST-CHAIRMAN, ECPD; R. J. S. PIGOTT, PRESIDENT, ASME; J. B. STIRLING, PRESIDENT, EIC; S. L. TYLER, SECRETARY, AICHE; AND E. S. LEE, FORMER CHAIRMAN, ECPD

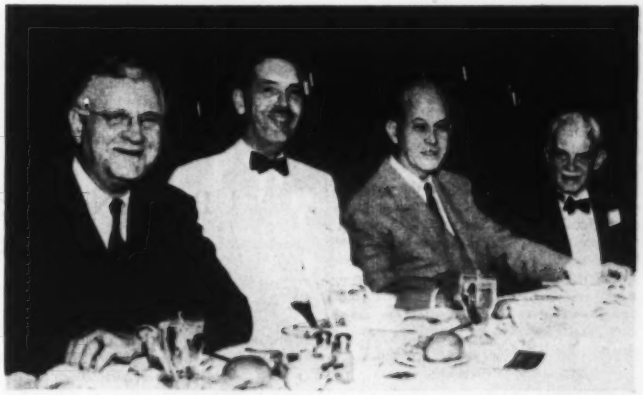
ula?" Taking part in the panel were: William L. Everitt, dean of engineering, University of Illinois, speaking for electrical engineering; H. E. Wessman, dean of engineering, University of Washington, on civil engineering; Neil P. Bailey, head, mechanical-engineering department, Rensselaer Polytechnic Institute, on mechanical engineering; George G. Brown, dean of engineering, University of Michigan, on chemical engineering; and Curtis L. Wilson, Missouri School of Mines and Metallurgy, on mining and metallurgical engineering.

Dinner Program

The annual dinner at the Furniture Club of America, was held jointly with ASEE on Friday evening immediately following a reception. Col. L. F. Grant, vice-chairman, ECPD, presided. He proposed a toast to the American Society of Civil Engineers to which Carlton S. Proctor, president ASCE, responded. Harry S. Rogers, chairman ECPD, presented the substance of his annual report under the title, "Translating Programs Into Action." In this report Dr. Rogers reviewed briefly the attempts that had been made during his three years in office to reorient and activate the program of ECPD and its committees. He summarized the important elements of the reports of the several standing committees and announced that "pilot-plant" operation of the Training Committee's program for developing the graduate engineer in his community during the "first five years after graduation," would be started in Cincinnati, under the direction of Cornelius Wandmacher in the fall of 1952. John F. Gordon, vice-president, General Motors Corporation, delivered an address on "Orientation and Development of Junior Engineers," in which he described in concrete terms the programs of General Motors in this field. Willis R. Woolrich, president ASEE, moved the vote of thanks.

E. G. Bailey Addresses Luncheon

In the dining room of the Western Society of Engineers, with Harry S. Rogers presiding, E. G. Bailey, past-president ASME, chairman of the board, Bailey Meter Company, delivered the luncheon address. Mr. Bailey answered in positive terms the question which served as the title of his talk, "Can Engineering Graduates Man a Company?" They were doing it very creditably in many cases, he said, and he posed another question, "How can each of us study the many cases at hand and draw some helpful conclusions regarding college curricula, selection of graduates, training, promotion, and organization of engineers for the best interests of our industrial economy?" He quoted some data on the ratio of engineers to employees in certain industrial establishments and stated that a typical company, which he had taken as an example, was not hiring enough engineers. "In my opinion," he said, "a company in this kind of business should have about 80 per cent of its executives of engineering training." He urged that engineering graduates be taken on "every year whether business is good or bad. One of the mistakes which many companies have made is to take on fewer graduates when times are a little slack.....We all short-changed the engineering graduates during the depression of the thirties, and then we needed them very much during the war. In 1949 all of the available engineers were not given proper jobs, and a shortage is being experienced today."



ECPD ANNUAL DINNER, CHICAGO, ILL., SEPT. 5, 1952

(*Left to right:* C. E. Davies, secretary, ASME; W. R. Woolrich, Fellow ASME, President, ASEE, and dean, University of Texas; J. F. Gordon, vice-president, General Motors Corporation; and L. F. Grant, field secretary, Engineering Institute of Canada, who was recently elected chairman, ECPD, and acted as toastmaster.)

In Mr. Bailey's opinion, "hiring the proper quota of new graduates is not enough. They should be enrolled in proper training courses and given every opportunity to learn the business and develop into positions of responsibility and leadership." In closing, Mr. Bailey called for a study of factual data of successful companies for the benefit of others. "The engineering profession should present to the top executives of American industry," he asserted, "illustrations and factual data relating to the successful use of engineers in such a manner that all will strive to improve their present methods for selecting, training, and advancing engineering graduates within their respective companies."

Report of Training Committee

Morning and afternoon sessions of ECPD on Saturday were held in the auditorium of the Western Society of Engineers for the purpose of presenting the reports of the several committees and of the representatives of the constituent societies. All of these reports are available in the Twentieth Annual Report of ECPD and are summarized in the report of the chairman.

Great interest was aroused by the report of the Training Committee, A. C. Monteith, chairman. Two years ago at the Cleveland meeting Mr. Monteith and members of his committee presented a comprehensive and challenging report on a study of the needs and opportunities for the continued education and professional development of young engineers in the communities in which they would spend the first five years after graduation. A program was proposed at that time which required financial backing, intelligent leadership, and the co-operation of industries, educational institutions, engineering societies, and other community groups wherever it should be put into effect. For two years the committee had attempted to uncover a community where the program could be introduced on a pilot-plant basis, a competent person to administer the program, and funds to cover essential expense involved. Shortly before this year's meeting in Chicago, this combination of factors was found at Cincinnati, Ohio, and the pilot-plant operation of the program will be introduced there this fall. Heading the venture in Cincinnati will be Prof. Cornelius Wandmacher, head of the civil-engineering department at the University of Cincinnati, who has been closely associated with ECPD and the activities of the Training Committee. He is the incoming chairman of the Training Committee and thus can personally correlate the work of the Committee with the development of the program at Cincinnati. He has the backing of the University, the engineering societies, and industries of Cincinnati.

Training Program at Cincinnati

The report of the Training Committee as presented at Chicago, dealt almost exclusively with the Cincinnati project. So recent were the circumstances which made initiation of the Training Committee program possible in Cincinnati, that the preliminary report had been written without mention of these happy developments. But the Council heard about them on Saturday morning in the verbal report of Mr. Monteith and from members of a panel of engineers from Cincinnati. This panel consisted of Professor Wandmacher, Arthur C. Burroway, past-president, Engineering Society of Cincinnati, and plant engineer, Cincinnati and Suburban Telephone Company; Frank Neuffer, dean of the evening college, University of Cincinnati; and Arvid S. Anderson, assistant director of industrial relations, Champion Paper and Fibre Company, Hamilton, Ohio.

Professor Wandmacher outlined the six ele-

ments of the proposed program of the Training Committee which had been covered in the Committee's report, "The First Five Years of Professional Development." These are:

(1) Orientation and training of the young graduate in industry. This is the phase of the program in which the interest and co-operation of industry, in particular the young man's employer, are essential.

(2) Continued education of the graduate engineer. To a large extent the program looks to the local education institutions to provide opportunities for the young man to take refresher courses, to extend his formal education into nontechnical fields, and to permit him to work toward a bachelor's degree in some other field than that in which he took his undergraduate degree, or to work toward a master's or a doctor's degree.

(3) Integration of the young man into the community in which he is working and living. Local engineering societies and sections of national engineering societies are the principal agencies through which the young man may find a means of easy access to those opportunities available to him to become part of the community.

(4) Registration as a professional engineer licensed to practice engineering.

(5) Self-appraisal of his personal talents, interests, and shortcomings, with a view to establishing a goal of his objectives and a measure of his progress toward them.

(6) Reading lists of technical and nontechnical books, prepared by ECPD.

The last three phases of the foregoing program, Professor Wandmacher pointed out, were largely the responsibility of the graduate himself to develop.

Mr. Burroway spoke principally of the Engineering Society of Cincinnati, organized in 1888, its objectives, organization, and programs, and of the 23 local sections of national societies and allied groups which are to be found in Cincinnati, the programs of which are co-ordinated through the Technical and Allied Council of Cincinnati, a service organization. He made clear that the atmosphere of Cincinnati was particularly favorable for the initiation of the pilot-plant operation of the Training Committee's program, citing the many engineering organizations, the University of Cincinnati, and the attitude of the industries which had been conditioned by the pioneering work of Dean Herman Schneider in co-operative education. Another favorable circumstance mentioned by him was the size of Cincinnati, which was neither too large nor too small for the purpose of assessing the value and practicability of the plan.

Dean Neuffer described the educational opportunities offered by the evening college of the University of Cincinnati in technical and nontechnical areas and made some interesting comments on the results and experiences gained in the past which would effect the probable success of the proposed program. Mr. Anderson, whose knowledge of ECPD and its work was limited but who had a genuine enthusiasm and concern for the training of young men entering the company he represented, gave the results of a survey he had made of the men with engineering training in that organization and described the training program it was administering.

In closing the presentation of the discussion offered by members of the panel, Mr. Monteith reminded members of the panel that the program developed by the Training Committee "is not worth a nickel if the individual is not willing and able to take advantage of the opportunity offered." There was a lot of lip service on the part of industry in the matter of training of its young employees. The ECPD program offered industry a challenge to play its part.

In concluding his remarks he reiterated a statement he frequently quoted: "Education is a journey, not a destination."

UPADI New Orleans Convention a Huge Success

THE Engineers Joint Council and The Engineering Institute of Canada were co-hosts to the Second Convention of UPADI (Pan-American Federation of Engineering Societies), Aug. 25 through 29, 1952, in New Orleans, La. Fourteen countries were represented at the convention which had a total registration of 314—171 from Canada and the Latin-American countries, 97 from the New Orleans area, and 46 from other cities in the United States. The participating countries included Argentina, Brazil, Canada, Chile, Colombia, Cuba, Dominican Republic, Mexico, Panama, Paraguay, Peru, Puerto Rico, United States, and Uruguay.

The convention elected as its president Carlton S. Proctor, president, ASCE. Other newly elected officers are: Manuel J. Puente, Cuba, first vice-president; Saturnino de Brito, filho, Brazil, second vice-president; and as secretaries: S. E. Reimel, United States; Rodolfo Ballester, Argentina; Juan V. Cabrerizo, Peru; Hector Cassaigne, Mexico; J. B. Stirling, Canada, president, EIC. The convention by acclamation elected Luis Giannattasio, Uruguay, honorary president. Dr. Giannattasio is currently president of UPADI.

The local organizing committee for the convention was under the direction of James M. Todd, past president and Fellow, ASME, who was also chairman of the U. S. Delegation. Tulane University provided the facilities for the meetings, where the delegates were welcomed by Dean Fred Cole.

UPADI Business Meeting

The principal business of the convention was the adoption of a Constitution and By-Laws, which was accomplished on August 27. It was agreed to finance the organization through a UPADI fund; a budget for the coming year, in the amount of $15,000, was adopted. Committees were established on administration, professional ethics, relations with other organizations, and technical matters. The convention decided to hold its next meeting in 1954 in Sao Paulo, Brazil, when the city will observe its four-hundredth anniversary.

U. S. DELEGATION TO UPADI CONVENTION

(*Left to right:* Messrs. Ackerman, Agthe, Browne, Hathaway, Proctor, Pratt, Pope, Todd, Burt, Kelly, Tyler, Lederer, Carey, Reimel, Steinberg.)

One full day was devoted to the presentation of technical papers on aspects of engineering education in the Western Hemisphere. Deans of engineering schools in Canada, United States, and Latin America participated in the program. The concluding feature of the convention was a group of papers on the economic development of Latin America. Ross W. Davidson of Ebasco, Inc., spoke for the United States.

Honors and Awards

A high light of the convention was the presentation by Dr. Giannattasio of a bronze plaque commemorating the Second UPADI Convention then under way in New Orleans, which was accepted by Carlton Proctor on behalf of EJC. The plaque is by the famous sculptor Jose Luis Zorilla de San Martin. Dr. Giannattasio also presented certificates to the delegates and other engineers in recognition of the work each had done in the foundation and promotion of UPADI. Manuel J. Puente, president, Sociedad Cubana de Ingenieros, presented a copy of the UPADI Constitution as adopted at the convention in Havana in April, 1951, and signed by the chief delegate of each nation participating in that convention. Mr. Todd received the signed copy of the UPADI Constitution for EJC. J. B. Stirling, president, EIC, presented plaques bearing the coat of arms of Canada to the presidents of the various delegations present at the New Orleans convention.

JAMES M. TODD (*right*) RECEIVING OFFICIAL SEAL OF CANADA FROM JOHN B. STIRLING (*center*) AND AUSTIN WRIGHT

Social Events

Another outstanding feature of the convention was a luncheon meeting under the chairmanship of T. G. LeClair, president, EJC, where a warm welcome to the delegates and others assembled was given by de Lesseps S. Morrison, Mayor of New Orleans. The women who attended the convention received an elegant sample of Southern hospitality. In addition to the luncheons at the Court of Two Sisters and the New Orleans Country Club, dinners, and the formal banquet, at which Mr. Stirling presided, on Friday evening, in the grand ballroom of the St. Charles Hotel, they were guests at a reception and cocktail party at International House of New Orleans, a barbecue at the Colonial Country Club of New Orleans, and a sight-seeing tour through the French Quarter. They had style shows, shopping trips, and other entertainment was provided for their enjoyment by the Women's Auxiliary to the Louisiana Engineering Society.

A number of inspection trips were organized for the delegates including the Kaiser Aluminum Works, the Port of New Orleans aboard the SS *Good Neighbor*, the U. S. Experimental Waterways Station in Vicksburg, Miss., and the Freeport Sulphur Company.

The officers of UPADI extended an invitation to all engineers in the Western Hemisphere to participate in the activities of the organization, particularly those engineers working or interested in Latin America.

GROUP OF ENGINEERING EDUCATORS AT UPADI CONVENTION

(Shown with Carlton S. Proctor, *left to right*, are Messrs. Sanlley-Gomez, Johnson, Steinberg, Tupper, Lassalle, Woolrich, Vejo, Ballester, Sterling, and Proctor.)

Kansas City Host to Seventh Annual Conference of ASME Petroleum Division

APPROXIMATELY 400 engineers attended the seventh annual conference of the Petroleum Division of The American Society of Mechanical Engineers which was held at the President Hotel, Kansas City, Mo., Sept. 21-24, 1952. Professional petroleum engineers from all sections of the country were represented.

Kansas City was host to this ASME Petroleum Division Conference for the first time since that Division was formed.

Thirty-seven technical papers were presented during the conference covering recent developments in pipe-line instrumentation, oil-well cementing practices, refinery design, shale-oil developments, pumping problems, new valve designs, gasoline plants, new materials for the refinery industry, and a symposium on refinery maintenance.

All the technical papers were enthusiastically received with an average attendance of 50 to 100 at each of the technical sessions which were held three at a time. The high light of the conference was the annual banquet, at which the principal speaker, R. J. S. Pigott, president and Fellow ASME, discussed "Developments of Motor Vehicles and Their Fuels." Mr. Pigott brought out some very good points pertaining to trend of design in the coming motorcar.

Howard E. Degler, chairman of the conference, presided at the dinner.

Other features of the conference were the Welcoming Luncheon where the main speaker was L. P. Cookingham, City Manager of Kansas City, Mo. His topic was "The Engineer in Community Development." The Heart of America dinner party with entertainment was a huge success.

National Metals Congress Held in Philadelphia

THE thirty-fourth annual National Metals Congress and Exposition, largest show in the metals industry, was held Oct. 20-24, 1952, in Philadelphia, Pa., and was attended by metals engineers from all parts of the country. More than 400 exhibits of metal production, fabrication, testing, and appli-

cation occupied 400,000 sq ft in four mid-town hotels and in Convention Hall.

Thirty-two papers on advanced metals sciences and new developments were presented at the technical sessions of the American Society for Metals. The American Welding Society, Society for Non-Destructive Testing, and Metals Division of the American Institute of Mining and Metallurgical Engineers also conducted technical sessions as part of the congress.

Prior to the opening of the congress-exposition ASM conducted a seminar on "Methods of Research" on October 18 and 19, which was well attended by engineers engaged in testing and predetermining the characteristics of metallic materials.

The congress-exposition is designed to keep metals engineers informed of the year's developments in the industry and to furnish exchange of ideas on the various problems of working with new metals under the mechanical stresses and temperature extremes typical in the jet and atomic age.

Eighth International Congress on Theoretical and Applied Mechanics

Congress Held in Istanbul, Aug. 20–28, 1952

THREE hundred and twenty scientists and engineers from 22 countries met at Istanbul Turkey, Aug. 20–28 for the eighth International Congress on Theoretical and Applied Mechanics.

The technical program was divided among five sections, but two of them, fluid mechanics and elasticity, plasticity and rheology, were so large that they had to be divided. As a result seven simultaneous sessions were in progress on some days. Of the 335 papers, 126 were in the field of fluid mechanics, 111 in elasticity and plasticity, 38 in mechanics of solids, 27 in statistical mechanics, thermodynamics, and heat transfer, and 43 in mathematics of physics and mechanics and methods of computation. It is expected that only abstracts of the papers will be published in the proceedings of the Congress. General lectures were given by J. C. Hunsaker, Hon. Mem. ASME, on Social Aspects of Aeronautics; by Sir Geoffrey Taylor, on Hydrodynamic Theory of Detonating Explosives; by J. von Neumann, on Automatic Computation and Hydrodynamics; by R. Courant, on Reciprocal Variational Problems and Applications to Problems of Equilibrium; by A. Kantrowitz, on Physical Phenomena Associated With Strong Shock Waves; by W. Tollmien, on Vibrations in Laminar Flows and the Theory of Turbulence (in German); and by A. Lichnerowicz, on Tensor Methods in Mechanics (in French). It is hoped that these lectures may be published in full.

German Scientists Attend Congress

A feature of the Congress was the renewed participation of German scientists with a delegation of 25 including such well-known men as Tollmien, Betz, Walther, Küssner, Marguerre, Pöschl, Schlichting, Schultz-Grunow. Austria was represented by Professor Federhofer. There were no participants from Russia or the satellite countries. Finland and Yugoslavia were represented as were India and Japan. The U. S. delegation of 97 was unusually large and included more than 30 members of ASME. Other countries represented in addition to the host country, Turkey, were Australia, Belgium, Denmark, Egypt, England, France, Greece, Holland, Iran, Israel, Italy, Norway, Sweden, and Switzerland.

These international congresses are arranged by a self-perpetuating committee of scientists from many countries, the U. S. members being H. L. Dryden, Fellow ASME, J. C. Hunsaker, Hon. Mem. ASME, Th. von Karman, Mem. ASME, and S. Timoshenko, Hon. Mem. ASME.

This committee met and took several actions of interest. The memberships of members from those countries with which satisfactory communication has been found impossible were suspended. The death of C. Koning of Holland, secretary, was announced and in his place W. T. Koiter was elected to the committee as secretary. J. Nielsen of Denmark and H. Sverdrup of Norway retired. The following new members were elected: K. Federhofer, Austria; G. Temple, Great Britain; R. Grammel and W. Tollmien, Germany; A. Signorini, Italy; F. Nakanishi, Japan. K. Erim was elected as president of the Eighth Congress, F. H. van den Dungen as president of the International Congress Committee for the period 1952–1956, and R. V. Southwell as treasurer. It was decided that the ninth congress would be held in Brussels, Belgium, in 1956.

International Union of Theoretical and Applied Mechanics

In 1946 in Paris there was organized the International Union of Theoretical and Applied Mechanics to promote the development of mechanics by the organization of additional international meetings, to co-operate with the Congress committee in the support of the international congresses, and to form a continuing link between national and international organizations engaged in scientific work in mechanics or in related sciences. The third General Assembly of IUTAM was held in Istanbul on August 21 and August 26. The general assembly consists of delegates from the adhering organizations and personal members. All of the delegations from the U. S., National Committee for Theoretical and Applied Mechanics were present, H. W. Emmons, Jun. ASME; N. J. Hoff, Mem. ASME; R. D. Mindlin, Mem. ASME; M. G. Salvadori, and R. J. Seeger, as well as three of the four U. S. personal members, H. L. Dryden, J. C. Hunsaker, and S. Timoshenko. In line with action proposed at the second general assembly, the number of personal members was reduced from 26 to 16 by one death, two resignations, four transfers to status of official representatives of adhering organizations, and three suspensions of membership pending more satisfactory communication. The following officers were elected to take office Nov. 1, 1952 to serve for four years except as noted: H. L. Dryden, president; J. Peres, vice-president; F. H. van den Dungen, secretary, 1952–1954; G. Temple, treasurer; M. Roy, N. J. Goff, and J. M. Burgers, assistant treasurers; K. Erim, R. Grammel, J. M. Burgers, and F. K. Odqvist, 1952–1954, members of Bureau (Executive Committee). The Netherlands and Finland were admitted as adhering nations. The fourth General Assembly will be held in Brussels during the second half of July, 1954.

International Astronomical Union

In co-operation with the International Astronomical Union, a second symposium on cosmical gas dynamics will be held at Cambridge, England, July 13–18, 1953. Attendance is by invitation of the organizing committee and persons specially interested should write directly to one of the members of the committee, J. M. Burgers, Th. von Karman, A. G. Kantrowitz, and Sir Geoffrey Taylor. The General Assembly appointed H. Favre, H. Le Boiteux, and M. Hetenyi, Mem. ASME, as a committee to organize a symposium on photoelasticity and photoplasticity in Brussels in 1954. A second symposium on nonlinear vibrations is projected for 1955.

UNESCO Support

Both the Congress and the General Assembly were supported by grants from UNESCO. A sum of $2500 was provided to facilitate the attendance of young scientists at the Congress and 14 grants were made to young men from 13 countries. An additional sum of $5000 was provided to partially defray transportation expenses of members of the General Assembly.

Mail This Christmas Package Early

THE other day we received a most eloquent letter. It came from Korea. It told quite simply how bad conditions had been this summer and how many would die from exposure and malnutrition this winter. Further, it told how our soldiers were planning to give up their Christmas dinner so that the pathetic, parentless Korean children—their number is staggering—will be assured at least one decent meal. As Lieut. Col. G. A. Bachman, Mem. ASME, says, "All this we can handle, but we are limited when it comes to putting clothes on their backs, which they sorely need."

He sincerely requests clothes. Send all your old clothes, for children, as well as for adults, and help make this a Christmas party never to be forgotten. Packages should be mailed immediately and addressed to "The Commanding Officer," Hq. 296th Transportation Truck Battalion, APO 59, C/O Postmaster, San Francisco, Calif.

In closing, Colonel Bachman added a sentence about toys—why don't you add a toy or two? It gives the package a heart.

Tentative Schedule 1953 RAC Meetings

Region	Location	Days	Date	Meeting Place
I	Worcester, Mass.	Fri.-Sat.	May 1-2	Sheraton
II	New York, N. Y.	Tues.-Wed.	May 5-6	Headquarters
III	Philadelphia, Pa.	Thurs.-Fri.	April 9-10	Engineers' Club
IV	Gainesville, Fla.	Sun.-Mon.	March 29-30	Thomas
V	Charleston, W. Va.	Mon.-Tues.	April 20-21	Daniel Boone
VI	Rockford, Ill.	Fri.-Sat.	April 17-18	Faust
VII	Phoenix, Ariz.	Fri.-Sat.	April 24-25	Westward Ho
VIII	New Orleans, La.	Sunday	April 12	Jung

Agenda Items for 1953 RAC Meeting

THE 1953 Agenda Committee has asked the sections to set up an Agenda Committee to expedite the collection, editing, and submission of agenda items. This Committee has been asked to canvass the membership for items and it is hoped you will support this effort one hundred per cent. The collection of these items and the invitation to the membership to submit them through their sections is a step in the democratic process by which the membership and the sections impart their ideas to the Council.

If you live within the boundary of a section and have not been approached, we suggest you submit your items to the secretary of your section. However, if you are outside the limits of a section, we suggest you address your items to the 1953 ASME Agenda Committee, 29 West 39th Street, New York 18, N. Y. Please study the wording of your proposed items to be sure they are clear and specific, and that there can be no misunderstanding as to intent. Also, be sure the wording is positive so that action can be taken either to "approve" or "reject" the item as worded.

The following is a suggested form we ask you to use in submitting items:

ASME AGENDA ITEM

PROPOSED BY ..... of the ..... Section

Date .....

Item: It is proposed that

Proposer's Comment:

.....
Signature

It is earnestly requested you submit your items immediately to make it possible to mail the first compilation of the agenda by the first of the year. The second compilation must be ready for distribution by March 15 the latest, so as to reach sections in adequate time prior to the Regional Administrative Committee meetings, the tentative schedule is shown in the accompanying box.

IIRD Conference on High Pressure Held in Cleveland, September 9-10

THE seventh national conference of the Industrial Instruments and Regulators Division of The American Society of Mechanical Engineers was held in Cleveland, Ohio, on September 9 and 10, in co-operation with the Instrument Society of America and the ASME Cleveland Section. Fourteen papers covering the techniques of measuring high pressure and the design and performance of high-pressure equipment up to 200,000 psi were presented in four technical sessions.

Due to the efforts of W. H. Howe, chief engineer, Foxboro Co., and D. H. Newhall, of the Harwood Engineering Corp., technical papers were presented from most of the engineering and research laboratories working in the field of high pressure, including those in universities industry, and government. Most fittingly, recent advances and probable extensions were reviewed by Prof. P. W. Bridgman, Harvard University, the pioneer research worker who received the Nobel prize for his development of Techniques for attaining and measuring extremely high pressures. Well over 200 of the leading engineers and scientists interested in the various aspects of high pressure were present at each session.

A luncheon held at the Cleveland Auditorium attended by about 150 guests featured an address on "Preparation for a Career in Industry," delivered by Dr. Elmer Hutchisson, acting president, Case Institute of Technology. In his talk he stressed the need for engineering colleges to give their students not only a thorough scientific background, but also a mastery of graphics and grammar and a sense of civic responsibility.

H. H. Gorrie was in charge of the arrangements for the ASME Cleveland Section and Richard Rimbach and P. V. Jones, Jr., for the Instrument Society of America.

Consideration is being given to having the high-pressure symposium published by the ASME provided enough advance orders are received. For further information write to Miss E. M. Murrayes, ASME Publication Sales Department, 29 West 39th Street, New York 18, N. Y.

Women's Colleges and Industry Could Help Meet the Manpower Shortage

INDUSTRY should work more closely with women's colleges to help meet the growing national shortage in technical personnel, according to Robert C. Sprague, president of Sprague Electric Company, speaking before a convocation on Science and Human Values held at Mount Holyoke College, South Hadley, Mass., October 3 and 4.

"An area of co-operation exists between women's colleges and technical industries which is now only at the beginning of its potential development," Mr. Sprague said.

Referring to the many women technical graduates who are already holding jobs in industry, Mr. Sprague expressed the view that the "nation's woman power remains relatively an untapped source in this area."

Women's colleges which now stress scientific instruction should take the initiative in providing facilities for research in highly specialized fields, he suggested. Some institutions for various reasons may be as well or better fitted than industry or a larger university to do certain levels of work, he pointed out. "Co-operative efforts of this kind are not only a service to the corporation which underwrites the project, but the stimulus of research invigorates teaching and awakens the interest of the serious student in science as a career. The more centers of such activity we can establish, the greater will be the numbers of qualified young women scientists and engineers to serve the nation's future needs," he said.

Mr. Sprague was one of six panel members at the convocation who called for joint action by scientists, industrialists, and educators to cope with a number of present trends and conditions that could retard the nation's scientific progress. Among the other panel members was Karl T. Compton, Mem. ASME, chairman of the Corporation, Massachusetts Institute of Technology.

Further opportunity for greater participation of industry in education exists in the co-operative training of engineers.

Engineers would be better fitted to serve industry today, and to be good citizens, he declared, if universities and technical schools placed more stress on cultural subjects, on learning to get along with people, and on the basic and applied sciences, "even at the expense of applied engineering." Specialized graduate training, he said, can be gained later when the engineer is on the pay roll. As

evidence of a desirable trend in this direction, he noted the many companies which are now giving employees time off and helping pay tuition for graduate work at nearby schools.

ESL Operations Featured in Colorful Slide Show

THE Engineering Societies Library, largest public library devoted exclusively to engineering, featured a continuous kodachrome slide show at the Conrad Hilton Hotel during the Centennial of Engineering delineating the operations of the library.

The exhibit was made up of kodachrome slides of the library, produced by the International Nickel Company, and caption slides emphasizing the volume and variety of work done by the library staff. Through this graphic display the members of the Founder Societies, their guests, and visitors became better acquainted with the facilities available to them through the library. The library is maintained by the four Founder Societies; namely, the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, and the American Institute of Electrical Engineers.

The story the slides told covered the thousands of books, reports, and periodicals received each year in the library, of which those of value are retained, so that more than 170,000 volumes are now available; systematic preparation of catalogs and indexes; service, either at the library or through the mails; literature searches—for research; the examination of articles for pertinence before being listed and annotated; translations made by experts in many languages and on a great variety of subjects; photoprints—over 50,000 a year supplied (microfilm copying also available); and book loans to members in the United States and Canada.

Requests for further information about the library or film should be addressed to Ralph H. Phelps, director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

Carnegie Dedicates Industrial Administration School

A MODERN million dollar building has been opened to students of the nation's first graduate school of industrial administration at Carnegie Institute of Technology, Pittsburgh, Pa. Official dedication took place October 2 and 3.

While the new building was still in the planning stage the school opened informally on Sept. 19, 1949, with classes meeting in existing Carnegie halls.

The school formally opened its doors in September, 1950, to 25 carefully selected students from both colleges and industrial organizations all over the nation. This autumn the school will have approximately 45 students—15 in the second year program and 30 entering students. These students come from the United States, Canada, England, Israel, Japan, and Thailand. Most of them have taken their engineering degrees at other universities and some have had actual experience in industry.

Because of the method of teaching, only a small number of men are admitted each year. Neither the usual college textbooks nor the standard lecture techniques are much in evidence. The student is largely responsible for his own work, with the professor guiding and advising. Thus the teaching methods, based on those developed in the Carnegie plan of professional education now in effect on the C.I.T. campus, allow the student to participate almost as actively as the professor in the classroom.

Recording and Controlling Instruments Conference to Be Held in Philadelphia

AS A means of serving the widespread interest in instrumentation and automatic control the Subcommittee on Recording and Controlling Instruments, American Institute of Electrical Engineers, is sponsoring a technical conference at the Benjamin Franklin Hotel, Philadelphia, Pa., Nov. 16–18, 1952. In order to broaden the service and scope of the sessions, the participation of the Instrument Society of America and of the Industrial Instruments and Regulators Division of The American Society of Mechanical Engineers has been secured.

Four technical sessions are included in the program, devoted respectively to automatic null-balance recorders, electrical controlling instruments, applications and systems, and new recording instruments. Nontechnical topics of general interest have been arranged for the dinner and two luncheons. The papers will be published in printed proceedings, which will be available after the conference.

Meetings of Other Societies

Nov. 12–16
American Society of Civil Engineers, inter-American convention, Condado Beach Hotel, San Juan, P. R.

Nov. 12–15
Society of Naval Architects and Marine Engineers, sixtieth annual meeting, Waldorf-Astoria Hotel, New York, N. Y.

Nov. 12–Dec. 10
UNESCO, general conference, seventh session, Paris, France.

Nov. 17–20
Canadian Institute of Forestry and Society of American Foresters, joint meeting, Montreal, Can.

Nov. 19–20
Industrial Hygiene Foundation, seventeenth annual conference, Mellon Institute, Pittsburgh, Pa.

Nov. 20–21
American Society for Quality Control, seventh Mid-West conference, Claypool Hotel, Indianapolis, Ind.

Nov. 30–Dec. 3
American Society of Refrigerating Engineers, forty-eighth annual meeting, New York, N. Y.

Dec. 3–5
Society for Experimental Stress Analysis, meeting and exhibition, McAlpin Hotel, New York, N. Y.

Dec. 7–10
American Institute of Chemical Engineers, annual meeting, Cleveland and Carter hotels, Cleveland, Ohio

(*ASME Calendar of Coming Events, see page 940*)

ASM Gives Three Engineering Teaching Awards

AS A direct aid in the teaching of more qualified engineers needed by industry, government, and private research, the American Society for Metals is this year awarding three cash prizes of $2000 each for the three best jobs of teaching turned in during 1951–1952 in the field of metallurgical engineers.

The three professors who have been selected by the Awards Committee to receive the awards this year are A. A. Burr, Rensselaer Polytechnic Institute; J. W. Spretnak, Ohio State University; and R. D. Stout, Lehigh University.

Established by ASM to stimulate greater interest in the best possible teaching performance and to increase the enrollment of students in this branch of engineering, the awards go to teachers who, upon documented records, have made vital contributions to their profession through outstanding teaching performances.

Compressed Air and Gas Institute Honored

THE Compressed Air and Gas Institute received an Award of Merit today at the annual meeting of the American Trade Association Executives held at the Royal York Hotel in Toronto, for its outstanding services to its industry and the public and especially for its notable educational program explaining and promoting the many uses and applications of compressed air and compressed-air equipment.

As a basic part of its program, the Institute developed a publication known as the "Compressed-Air Handbook," a volume which has become the authoritative source for information in this field.

A second element of the program includes an intensive co-operative program carried on in conjunction with the faculties of engineering colleges throughout the country.

Copies of the material published by the Institute are available at the headquarters of the Compressed Air and Gas Institute, 122 East 42nd Street, New York 17, N. Y.

People

FRANK P. TISCH, Mem. ASME, chief engineer, Pheoll Manufacturing Company, Chicago, Ill., has been awarded a certificate of service by the American Standards Association in recognition of his work in the development of American Standards. He is a member of the ASA Standards Council, representing ASME.

* * *

WALTER L. HUBER of San Francisco, Calif., has been elected president of the American Society of Civil Engineers for one year. He was inducted, as were two newly elected zone vice-presidents and eight district directors, at the society's annual business meeting, Oct. 15, 1952, in the Statler Hotel, New York, N. Y.

WILLIAM L. BATT

WILLIAM L. BATT, past president and Hon. Mem. ASME, Minister in charge of the Economic Cooperation Administration mission to the United Kingdom and former president of SKF Industries, Inc., has been named to received the Howard Coonley Medal for distinguished service in the standardization movement by the American Standards Association. Presentation of the medal will be made November 25, at the 34th annual meeting of the association in the Waldorf-Astoria Hotel, New York, N. Y.

* * *

ROBERT J. PAINTER has been elected executive secretary of the American Society for Testing Materials. At the same time it was announced that Raymond E. Hess was elected associate executive secretary and editor in chief.

* * *

JOHN CHIPMAN, head, department of metallurgy, Massachusetts Institute of Technology, is the winner of the 1952 Albert Sauveur Achievement Award, presented by the American Society for Metals. Also Dr. Chipman was chosen by the Italian Metallurgical Society as the winner of the 1952 Losana Gold Medal for making the greatest contribution to international research and co-operation in the field of metallurgical engineering.

* * *

ALFRED J. BUCHI, ASME Melville Medalist, 1937, one of the world's foremost authorities on Diesel engines, received the George R. Henderson Medal of The Franklin Institute at the Institute's Medal Day ceremonies on October 15.

* * *

H. H. MAGDSICK, illuminating engineer, General Electric Company, Nela Park, Cleveland, Ohio, received the 1952 Illuminating Engineering Society Gold Medal. The presentation was made at the opening session of the society's national technical conference, Edgewater Beach Hotel, Chicago, Ill.

* * *

JOHN L. YOUNG, vice-president in charge of engineering, United States Steel Company, has been elected president of the Association of Iron and Steel Engineers for 1953. L. F. COFFIN, Mem. ASME, was among the newly elected honorary directors.

* * *

N. A. HALL, Mem. ASME, has been appointed director of the Engineering Sciences Division, Office of Ordnance Research, U. S. Army, Durham, N. C. He goes to OOR on leave of absence from the University of Minnesota.

* * *

G. L. LARSON, Fellow ASME, chairman mechanical-engineering department, University of Wisconsin, received a Wisconsin Utilities Association citation Oct. 2, 1952, during the convention held at the Schroeder Hotel, Milwaukee, Wis.

* * *

F. H. PROUTY, Fellow ASME, partner, Prouty Bros. Engineering Company, Denver, Colo., was recently awarded an honorary DS degree by the University of Colorado.

* * *

PAUL WRIGHT, Fellow ASME, was appointed honorary vice-president ASME to represent the Society at the dedication ceremonies of the John Jenkins Wilmore Engineering Laboratories, Alabama Polytechnic Institute, in Auburn, Ala., on Oct. 11, 1952.

* * *

D. B. STEINMAN, for services to the Allied Armies during World War II, was honored by the Order of Chevaliers de la Croix de Lorraine et des Compagnons de la Résistance. He was awarded the Cross of Knight and the honorary title of Companion of the Resistance.

Engineers Need Training in Literature Use

THE engineering library, the engineering literature center, is one of the most expensive laboratory units maintained by any organization, industrial or educational. Its cost is not justified if it is not consistently used to support current operations and validate anticipated interests of an organization.

Assuming that many engineers do not extract full value from engineering literature, the Engineering Literature Project of the American Society for Engineering Education is trying to find out why this is true and what can be done about it. What does the practicing engineer think of the value of literature use, literature searching? Does he think it isn't necessary, or on the other hand, that it is pretty important for an engineer to know his way around in a library?

Briefly, the project wants to know the opinions of practicing engineers on the following points: (*a*) What value they place on library or literature know-how; (*b*) what training they have had in this direction; (*c*) whether they think such training is desirable or even essential for prospective engineers; (*d*) what ideas they have on the sort of training, if any, which should be given.

A questionnaire, which can be completed by simply using checkmarks in answer to the foregoing questions, is being sent 1000 engineers whose names have been selected at random from society and association directories. Mailing of the questionnaires is scheduled for Nov. 24, 1952.

Results of this survey will be of great assistance either in developing for future engineers a form of instruction emphasizing the engineer's outlook on the use and need of literature and of library know-how; or in forgetting the whole thing. A copy of the questionnaire is available upon request by addressing: Engineering Literature Project, ASEE, % E. A. Chapman, Rensselaer Polytechnic Institute, Troy, N. Y.

ASME Calendar of Coming Events

Nov. 30–Dec. 5
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(*Final date for submitting papers was July 1, 1952*)

April 15–16, 1953
ASME Management Conference, Rockham Building, Detroit, Mich.
(*Final date for submitting papers—Dec. 1, 1952*)

April 28–30, 1953
ASME Spring Meeting, Deshler-Wallick Hotel, Columbus, Ohio
(*Final date for submitting papers—Dec. 1, 1952*)

May 24–28, 1953
ASME Oil and Gas Power Division Conference, Hotel Schroeder, Milwaukee, Wis.
(*Final date for submitting papers—Jan. 1, 1953*)

June 28–July 2, 1953
ASME Semi-Annual Meeting, Hotel Statler, Los Angeles, Calif.
(*Final date for submitting papers—Feb. 1, 1953*)

Sept. 21–25, 1953
ASME Industrial Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Chicago, Ill.
(*Final date for submitting papers—May 1, 1953*)

Sept. 28–30, 1953
ASME Petroleum Mechanical Engineering Conference, Rice Hotel, Houston, Texas
(*Final date for submitting papers—May 1, 1953*)

Oct. 5–7, 1953
ASME Fall Meeting, Hotel Sheraton, Rochester, N. Y.
(*Final date for submitting papers—July 1, 1953*)

Nov. 29–Dec. 4, 1953
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(*Final date for submitting papers—July 1, 1953*)
(*For Meetings of Other Societies see page 948*)

Literature

Executive Research Survey

THE Professional Engineers Conference Board for Industry, "Executive Research Survey Number 1," is a 48-page study which pools the experience in communications of more than 350 leading industrial companies

and engineering organizations, employing some 50,000 engineers and a total of 2 million persons. It is number one in a series of Research Reports based on National Executive Surveys conducted by the National Society of Professional Engineers, through its Professional Engineers Conference Board for Industry.

It is a guide book and manual for the executive in companies and organizations employing engineers and engineering services. For the engineer, the student engineer, the engineering educator, it is an appraisal and textbook of the values of communications in the practice of the professional man.

A copy of the survey may be purchased from the National Society of Professional Engineers, 1121 Fifteenth Street, N. W., Washington, D. C., at $2 a copy.

Steel-Piping Materials

THE 1952 eighth edition of ASTM Specifications for Steel Piping Materials sponsored by ASTM Committee A-1 on Steel contains in their latest approved form (as of late February) the 56 widely used ASTM specifications for carbon-steel and alloy-steel pipe and tubing, including stainless.

Materials covered include: pipe used to convey liquids, vapors, and gases at normal and elevated temperatures; still tubes for refinery service; heat-exchanger and condenser tubes; boiler, superheater, and miscellaneous tubes. To make the volume more complete there are also included specifications for the following materials used in pipe and related installations: castings; forgings and welding fittings; bolts and nuts. The ASTM standard classification of austenitic grain size in steels (E 19) with two sets of charts; also the American Standards covering wrought-steel and iron pipe (B36.10) and stainless-steel pipe (B36.19) are a part of the book.

New specifications cover: seamless and welded steel pipe and tubes for low-temperature service; seamless ferritic-alloy-steel pipe for high-temperature service; forged or rolled carbon and alloy steel flanges, forged fittings, and valves and parts for low-temperature service; ferritic and austenitic-steel castings for high-temperature service; ferritic-steel castings for pressure containing parts suitable for low-temperature service.

Numerous Emergency Alternate Provisions applying to specifications in this compilation have been issued and are furnished with this volume. (These Emergency Alternate Provisions are issued by ASTM in accordance with a special procedure in the interest of expediting procurement or conservation of materials during the period of National Emergency. They are intended for use where they may be considered by the purchaser of the material as a permissible alternate for the specific application or use desired.)

This book is of distinct service to those concerned with pressure piping, power generating, the petroleum field, the distribution of gas, oil, water, and the like, and to individuals in every industry where these materials are important.

Copies of this 384-page publication, in heavy paper cover, can be obtained from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., at $3.50 each.

Bolt, Nut, and Rivet Standards

A NEW 256-page book entitled Bolt, Nut and Rivet Standards has just been published by the Industrial Fasteners Institute. This completely revised and enlarged book replaces the first edition issued in 1941, and is the only publication which contains all current standards for commercial fasteners. It was published both to aid production in manufacturers' plants and as a service to users in acquainting them with accepted standards of nomenclature, dimensions, sizes, and other practices.

Among the new standards included in the book are those for round-head bolts (carriage bolts), plow bolts, track bolts, studs, slotted and recessed screws, socket-head screws, small solid rivets, large rivets, unified screw threads, and the newly-adopted square and hexagon bolts and nuts unified dimensionally with Britain and Canada. Also, there is a large section listing weights and stock production sizes; and informative discussions on screw threads, gaging practices, fastener materials, manufacturing processes, and a complete list of all recognized fastener specifications.

Copies of Bolt, Nut and Rivet Standards may be obtained at $3 a copy from the Industrial Fasteners Institute, 3648 Euclid Avenue, Cleveland 15, Ohio.

Coming Meetings

NSF Compiles List of International Technical Meetings

A LIST of forthcoming international and foreign meetings of interest to American scientists has been compiled by the Office of Scientific Information, National Science Foundation. While the list was originally prepared for internal use, a limited number of copies are available upon request to scientists and scientific organizations. NSF, 2144 California Street, N. W., Washington 25, D. C.

The present list contains information on dates, places, names of meetings, sponsors, topics of discussion, and offices where specific questions may be answered.

Gages

APPLICATION and utilization of the bonded resistance-wire strain gage in engineering measurement and automatic control in industry are to be covered in a series of all-day, educational conferences scheduled for five western cities during November. Programs will provide a "Parade of Ideas" on the past, present, and future uses of SR-4 strain gages with actual SR-4 devices demonstrated.

Conferences will be held as follows: Southern Methodist University, Nov. 11-12; University of New Mexico, Nov. 14; University of Southern California, Nov. 18-19; Pacific Gas & Electric Auditorium, San Francisco, Calif., Nov. 21; and University of Washington, Nov. 25.

The program includes a new sound film, "The SR-4 Strain Gage at Work," a lecture on stresscoat and dynamic instrumentation by Greer Ellis, Mem. ASME; classroom sessions, and demonstrations of many types of strain-gage devices. Devices include those for load and pressure measurement and control, weighing scales, process instrumentation, automatic control of machines, torquemeters, testing machines, extensometers, accelerometers, and others.

Aircraft Noise

A SYMPOSIUM on aircraft noise will be part of the coming meeting of The Acoustical Society of America at San Diego, Calif., Nov. 13-15, 1952.

This symposium will last the entire day of Friday, Nov. 14. The speakers who will take part are generally recognized for their competence in this field. They come from the East, Middle East, and West, and are drawn from military, academic, and industrial organizations. The subjects to be covered include the physical characteristics of aircraft noise, the propagation of sound as influenced by terrain and meteorological conditions, noise-control measures and structures, and noise problems of the manufacturer.

A symposium on loss of auditory function after exposure to sound will also be part of the Acoustical Society Meeting; it will be held Saturday, Nov. 15, 1952.

NAPRE Convention at Dallas

THE Dallas Chapter, National Association Practical Refrigerating Engineers, will be host to the forty-third annual convention of the national group to be held November 12-14 at the Adolphus Hotel, Dallas, Texas.

Fourteen technical papers and discussions are to be presented at the convention. Speakers' subjects range from design of air-conditioning systems to the design of cold-storage plants; from testing and rating of refrigeration-blower coils to the latest trends and developments in evaporator designs; from the education of an engineer, to operating and maintenance procedures; from automatic plant operation to refinery refrigeration, and from refrigeration on rails to modern brewery practice; and from precooling to fast freezing practices.

Research

THE first regular meeting of the Operations Research Society, which was formed by a group of leading scientists in May, 1952, will be held at the National Bureau of Standards in Washington, D. C. on November 17-18.

The Society, whose purpose is to promote the application of scientific methods to business and military problems, will hear and discuss papers involving industrial applications of Operations Research; waiting lines; inventories and the use of probability techniques in industry; and the newly-developed Monte Carlo method for handling problems which cannot be solved with ordinary equations. There will also be a research panel on the solution of new problems and the development of new methods which have arisen in industry in the last year.

Further information about the meeting may be obtained from the secretary of the Society,

John B. Lathrop, 30 Memorial Drive, Cambridge, Mass.

Work Measurement

THE second annual Work Measurement Clinic, "Modern Utilization of Time Study," will be held in the Hotel Syracuse, Syracuse, N. Y., Nov. 20–21. Phil Carroll, Fellow ASME, Registered Professional Engineer, and author of several texts on time study will conduct the meetings. The conference is jointly sponsored by the Society for Advancement of Management and Syracuse University.

The intensified and practical nature of this conference will enable plant managers, superintendents, engineers, foremen, cost accountants, and office executives to better use the modern tools of time study and to get more for each time-study dollar.

Information relative to the conference may be held by addressing Society for Advancement of Management, % The Nestlé Company, Inc., Fulton, N. Y.

Corrosion

WESTERN Region of the National Association of Corrosion Engineers, which comprises the states of Washington, Oregon, California, Idaho, Nevada, Utah, and Arizona, will hold its second annual Corrosion Conference, Nov. 20–21, 1952. The meeting at the Biltmore Hotel, Los Angeles, will consist of lectures and discussions by nationally known corrosion engineers.

W. M. Schilling, Southern Counties Gas Co., 4818 Beck Ave., Bell, Calif., chairman of the conference, will receive reservations. Registration fee is $3.

Welding

THE American Welding Society has announced its plans for conducting a national spring technical meeting at the Shamrock Hotel in Houston, Texas, June 16–19, 1953, accompanied by a four-day Welding and Allied Industry Exposition in the Shamrock Hall of Exhibits, adjoining the hotel.

The technical paper program will include papers and symposiums on welding and allied subjects of national and regional aspect and technical treatise subjects of interest to the specialized industry of the Southwest; aircraft, oil, chemical, shipbuilding, and so on. It is expected that this comprehensive program will draw a very large attendance of top executives, engineers, metallurgists, production men, fabricators, process plant men, steel makers, ship builders and all of the welding profession.

The Society has selected Houston, Texas, for its initial spring meeting and allied exposition activity due to what it considers to be the tremendous potential for even further expansion and development in that area which has during the past two decades expanded to an unprecedented degree. For example, the population of the City of Houston has increased from 170,000 in 1930, to better than 650,000 in 1952 and the surrounding Southwest has grown proportionately.

Junior Forum

Conducted by Joseph Schmerler[1]

Method in Engineering

ALL creatures endured the forces of nature until the mind of man matured. Then man's desires sought satisfaction by invention of tools to strengthen his hand. But toolmaking brought civilization with collective cares outreaching the ability of arms even when aided by the lever and wheel. Slowly our forebears began to discover natural laws that explained the drawing of power from falling water, wind, and steam. It was only in our fathers' time that electricity on wires, and then on wireless waves encircled the earth; yet we have cradled atomic change and released the latent energy that lights the stars, thereby threatening the existence of our enemies and of our own children. It is the engineer's destiny to control and direct power in order to 'provide for the common defense, promote the general welfare,' and so to help 'secure the blessings of liberty to ourselves and our posterity.'

"As an engineer you are given a favored part in this great design; without you the plan would be less perfect. When you build a bridge, design a dam, perfect a process, or link power lines together you play a role in the achievement of human destiny." (From "The Gift of Engineering," by L. E. Grinter, vice-president, ASEE.)

In this achievement of human destiny about which Mr. Grinter speaks, it is important to understand the type of problems engineering solves and the processes of analysis which are used. Prof. Hardy Cross of Yale, in his book, "Engineers and Ivory Towers," explains that the work of the engineer is by nature synthetic..... "it consists of putting together the fragments of human relations, from science, from art, from craftsmanship to produce new assemblages. Simply making an analysis of all the elements, all the data of the problem, does not mean a solution has been obtained. These data must be put together, made into a new assembly that involves a large imaginative element put together with due respect to the relative importance of the elements and to the probability of simultaneous occurrence; and all this must be done with some intuitive vision of what is wanted and of what can be got. Then, and then only, has there been a solution of an engineering problem."

Engineering is the means through which goods are produced which fulfill the needs and conveniences of man. Any desire that is to be satisfied must legitimately answer three questions. "Why should it be," "What shall it be," and "How shall it be used"?

Having satisfied the first question as a policy, the next two questions "what" and "how" become a matter for engineering solution. Actual determination of what form the item shall take involves consideration of materials and their availability, physical appearance, time requirements, economy and cost, management, and eventual operating procedures.

These elements in a problem are sources of information. Each is a unit by itself. Rarely are the units in such agreement that a straight line of design can be used. More often than not even the information within the individual unit does not all completely agree. It therefore becomes the engineer's function to provide the necessary correlation between the individual pieces of information.

There is no book formula with which to produce this correlation. It is the task of the analytical engineer to use common sense in judgment of the relative values. Books may provide the background for such judgment, provide a fundamental set of tools. In the end though, book information, practical experience, intuitive hunches, and so on, must all be given weight by the engineer in his solution.

In this segment of the problem analysis the elementary design results from a tug of war between the variables. Some convenience may be sacrificed to cost, beauty to strength, precision to standard parts, and durability to availability. The balance depends upon the degree of stress which is placed on each of the pertinent elements. For that reason, identical problems solved at a different time or place will rarely conclude in identical answers.

When the planning battle has ended and specifications "frozen," mechanical design can begin. Creativeness gives way to standardized analysis. By a series of formulas engineering work can be turned out on an assembly-line basis. No matter who does this part of the work, it will always turn out the same because of the rigid limits set by standard formulas. Within its sphere of application this standardization is useful because it provides a convenient means of duplicating results which experience has shown will stand up. It also allows men of lesser training to turn out a large volume of engineering work so that the engineer is able to spend a greater portion of his time on the more creative aspects of the problem.

This approach to a problem is simply engineering method. It provides a blend of judicious planning, where decisions are variable and common sense essential, with rigid standard solutions of mathematical design details. Its scope is such that an engineer confronted with a request to develop something for the use or convenience of man, can attack and solve his problem with a maximum of clarity.

[1] Design Engineer, Celanese Corporation of America, New York, N. Y. Jun. ASME.

Education

Institute of Gas Technology Fellowships

THE Institute of Gas Technology, affiliated with Illinois Institute of Technology, Chicago, Ill., announced the availability of 15 two-year fellowships for the training of men who are interested in securing positions in the nation's newest industrial giant—utility gas—which since World War II has made great strides.

The gas industry has been growing faster than its supply of men for supervisory and administrative positions. The Fellowship Program of the Institute of Gas Technology is designed to train carefully selected young men at master's and doctoral levels for positions of responsibility in the several phases of the manufactured and natural-gas industries: production, distribution, utilization, administration, research, and sales. The program was initiated in 1941 and has become the single source of graduate students specially trained in gas technology.

The program effectively co-ordinates plant experience, theoretical study at the graduate level, and independent research into a completely adequate presentation of the requirements and the understanding necessary for rapid advancement to administrative levels. The gas industry has created the educational and research facilities and assumed the financial burden for the Fellows' tuition, fees, stipend, and summer plant training.

Applications for fellowships are invited from seniors and graduates in chemistry, chemical engineering, mechanical engineering, physics, petroleum engineering, and related fields, who are American citizens, in good health, and under 28 years of age.

Application forms and further information can be secured by a student from his college department head or placement director, or from the personnel manager of the local gas company, or by writing to the dean of students, Institute of Gas Technology, Technology Center, Chicago 16, Ill.

NSF Awards in Research

THE National Science Foundation has announced approval of 29 additional research grants totaling $263,535 in the biological and physical sciences.

This is the final group of research grants to be approved during fiscal year 1952, ending June 30, under the Foundation's program for support of basic research. During the year 98 grants were made totaling $1,181,175.

Research fields included are astronomy, chemistry, developmental biology, earth sciences, engineering, environmental biology, experimental psychology, genetic biology, mathematics, microbiology, molecular biology, physics, regulatory biology, and systematic biology.

While grants were selected primarily on the basis of scientific merit, the Foundation is attempting in its research support program to encourage the development of research activities in smaller institutions throughout the United States. This policy not only will increase the research potential of the nation but it will result in marked improvement in the teaching of science at both the graduate and undergraduate levels.

Material Handling

IN order to make it possible for engineering students better to equip themselves for fruitful industrial service in the fast-growing technology of material handling, the 78 major manufacturers of material-handling equipment (acting through their trade association, The Material Handling Institute) and the nation's 3000 professional material-handling engineers who are members of the American Material Handling Society have joined hands with leaders in the field of engineering education to form an autonomous College-Industry Committee on Material Handling Education.

The committee's work will be dedicated to five clear-cut objectives: To make available to colleges and other study groups material of recognized quality for use in courses on material handling; to initiate development of new material, not presently available, for use in such courses; to become known as a source and authority on sound good-quality information for material-handling courses; to stimulate more teaching of material handling (and the importance of material handling) in the nation's colleges and universities, and to determine from industry what skills and understanding it requires in the material-handling engineers the colleges turn out.

Although conceived jointly by the AMHS and the MHI, the new body will be free-standing and take its cues directly from the engineering colleges in answer to whose perennial requests for better educational material the activity was organized. The committee characterizes itself as representing "an industry united to work with the institutions which guide the destinies of the young men entering industry."

The end-result of the program should be a larger national force of technically trained manpower—to make the most of that one of every four production dollars spent for merely pick up, putting down, moving, storing, and transporting goods, without adding one mite to their value.

Co-Operative Research

THE Division of Co-operative Research, an important top-level link between Columbia's new Engineering Center and industry, has been activated with the appointment of Dr. John G. Dean, widely known research scientist, as director, according to an announcement by Dean John R. Dunning, Mem. ASME, of the School of Engineering.

The Division has been established to strengthen associations between industry and Columbia, to expedite basic and applied research of mutual interest on the highest level, making use of Columbia's full facilities and to initiate conferences and seminars on engineering and scientific topics important to industry.

Research, further implemented by active and advisory committees, drawn both from industry and from the engineering and scientific staffs at Columbia, is to concern itself with such fields of inquiry as nuclear technology, fluid mechanics, communications, controls and electronics, industrial management, biochemical and food technology, petroleum technology, metallurgy and refrigeration, corrosion engineering, waste disposal and air pollution research, aeronautical structures research, and many others. In most cases these researches have been under way for varying periods of time at Columbia but are to be expanded under the program of Co-operative Research within the new Engineering Center.

Casting Institute Annual Meeting Reports Technical Progress, Elects Officers

AT the twelfth annual convention, members of the Alloy Casting Institute, a technical association of high-alloy foundries, were given a comprehensive picture of the accelerated progress being made in the vital field of high-alloy casting materials and techniques.

Reporting to the assembled technical and operating executives of the nation's high-alloy foundries, R. H. English, chief metallurgist, National Alloy Steel Division of Blaw-Knox Company, Pittsburgh, Pa., gave a detailed picture of intensive technical research being sponsored by the Institute at the Ohio State University and at Battelle Memorial Institute, Columbus, Ohio. Research at Ohio State has been carried out on the evaluation of titanium as a substitute for columbium in the cast stainless-steel alloys.

The research at Battelle, according to Mr. English, was concentrated on high-temperature work, with the majority of the effort being devoted to a study of the 20 per cent chromium, 9 per cent nickel composition type for elevated-temperature service (recently announced by the Institute). Maximum and minimum amounts of chromium were investigated, as they affect thermal fatigue properties and strength at elevated temperatures. Other high-temperature programs scheduled for the following year include a study of the correlation of thermal fatigue and stress rupture properties of the 35 per cent nickel, 15 per cent alloy composition range. Mr. English also announced the completion of a study of the effect of composition on resistance of high alloys to corrosion by neutral heat-treating salts. The results of this program will be presented before the annual Metal Congress in October, 1952.

Results of research at still another technical institution, the Massachusetts Institute of Technology, were reported on behalf of the Shop Practice Committee by W. T. Bryan of the Duriron Company, Dayton, Ohio.

This research had been devoted to the improvement of surfaces on high-alloy castings. Recommended procedures for foundry control were outlined by Mr. Bryan.

Actions of the ASME Executive Committee

At a Meeting at Headquarters, Sept. 30, 1952

A MEETING of the Executive Committee of the Council was held in the rooms of the Society on Sept. 30, 1952. R. J. S. Pigott, chairman, presided. In addition to Mr. Pigott there were present: H. R. Kessler, R. A. Sherman, and W. F. Thompson of the Executive Committee; E. J. Kates, assistant treasurer; E. G. Bailey, past-president; H. E. Martin, director at large; C. E. Davies, secretary; and Ernest Hartford, executive assistant secretary. The following actions were of general interest.

1952 Dues-Exempt Members

The Secretary reported that as of Sept. 30, 1952, 223 ASME members have become exempt this year from further payment of dues under the rules of the Society. Approximately 75 letters were received from this group expressing appreciation.

One of the members of this group donated $100 to the Society "so that it can continue as an outstanding example in engineering science and development work for all mankind." It was voted to express appreciation to the donor for his generous contribution and proposed that the donation be given to the Old Guard Fund for assisting young ASME engineers.

1952 Awards

Upon recommendation of the Board on Honors, the following awards for 1952 were approved: Charles T. Main Award to Israel E. Rubin, Cooper Union School of Engineering, for his paper, "Engineering as a General Education"; and the Undergraduate Student Award to George L. Stocking, Iowa State College, for his paper, "High-Temperature Electrical-Resistance Strain Gages."

1953 Charles T. Main Award

The following topic was approved for the 1953 Charles T. Main Award: "The Engineer's Contribution to the Increase in Standard of Living."

Boiler Code Committee

The Secretary reported that the American Standards Association presented a certificate honoring the Boiler Code Committee of the Society during the Centennial celebration in Chicago. Appreciation of the Council was expressed to the Boiler Code Committee for the splendid performance of the Committee which brought this honor to the Society.

Certificates of Award

Certificates of award were approved for the following retiring chairmen: Ely C. Hutchinson, Board on Honors; and David Larkin, Membership Development Committee.

Certificates of award were also approved for the following retiring chairmen of Sections: A. M. Deiters, Atlanta; W. D. Boynton, Baltimore; G. S. Myers, Birmingham; E. H. Barry, Boston; R. G. Tessmer, Buffalo; C. R. Mummery, Canton-Alliance-Massillon; J. R. Kruse, Chattanooga; D. J. Bergman, Chicago; F. A. Boddy, Detroit; R. C. Robertson, East Tennessee; K. P. Hanson, Eastern North Carolina; W. T. Tiffin, Florida; J. A. McPherson, Jr., Greenville; M. H. Linn, Iowa-Illinois; W. S. Johnson, Metropolitan; J. G. Van Vleet, Milwaukee; W. R. Trusler, Ontario; G. M. Muschamp, Philadelphia; H. R. Hughes, Jr., Piedmont-Carolina; R. O. Slattery, St. Louis; W. M. Davis, Savannah; A. W. Weber, Southern Tier; W. S. McConnor, Toledo; and F. G. Carrington, Virginia.

A certificate of award was granted to Alvin L. Clark, retiring secretary-treasurer of the Toledo Section, 1949–1952.

Certificates of award were also granted to the following past chairmen of Sections: St. Louis, J. C. Parmely, 1946–1947; G. V. Williamson, 1947–1948; F. V. Hartman, 1949–1950; Southern Tier, W. G. Baird, 1946–1947; R. W. Ramage, 1949–1950; C. R. Otto, 1950–1951.

It was also voted to grant certificates of award to the entire Nominating Committee and to adopt as a policy of the Society the issuing of certificates to the members of the Nominating Committee each year.

EJC Constitution

The secretary was directed to forward formal approval of the changes in the EJC constitution suggested at the July 18, 1952, meeting of EJC.

ECPD

Letter-ballot approval of the formal report on activities of ASME on ECPD matters presented by the ASME representatives at the ECPD Annual Meeting, Sept. 5–6, was confirmed by the Council.

Engineering Foundation Support

The Council voted to support the request of the American Society for Engineering Education for a grant of $6000 from The Engineering Foundation to further the work of its committee on the evaluation of the status of engineering education, with the understanding that such action has the approval of the ASME Board on Education and Professional Status.

EJC Discusses Centennial, Manpower, and International Relations

A MEETING of the Engineers Joint Council was held in the Engineering Societies Building on September 19, 1952. T. H. Chilton, acting chairman, presided.

Centennial of Engineering

It was reported by E. L. Chandler that the over-all outcome of the Centennial was very good, and that both the Convocation and the meetings of the individual societies were successful. Mr. Chandler told about some of the high lights of the Centennial and the difficult and unpredictable situations which arose. A total of 26,000 engineers registered. It is expected that the Centennial papers will be published and that they will be considered an extremely valuable record.

Manpower Program

Progress made by the Engineering Manpower Commission in its manpower campaign was reported by Eugene Seraphine. Favorable comments were received on the penetration among students of the EMC poster and tangible results are expected in increased engineering enrollment. The school program will be continued by keeping in touch with the 500 local delegates set up as small manpower groups around the country. Industrialists and educators are now supporting the program by making it possible for students to attend open-house meetings.

This program will be augmented by an Advertising Council campaign beginning with advertisements in prominent company magazines appealing to parents and youth to consider the opportunities in engineering. Support from industry is expected in providing funds to promote 3-4 color advertising in magazines, car cards for subways, and the like. General radio and TV programs are also included in their plans.

The EMC meeting at the Centennial was reported to be very successful with an attendance of 600 and a good press coverage with articles and editorials in some of the leading newspapers. Speeches made at the meeting will be printed in a pamphlet. An EMC display on view excited considerable interest and resulted in requests for slides. These slides have been made up and talks to go with them will also be available.

Current phases of the engineering manpower situation were discussed, including the movement by the Army and Air Force to change ROTC units—so as to integrate all services in one type of program. It was voted to bring this matter to the attention of the National Engineers Committee and that any action which it might take be reported to EMC.

International Relations

Activities of the Committee on International Relations were reported by E. A. Pratt, chairman. A reception was held in The Engineers' Club, New York, N. Y., August 21, for a small group of Swiss engineers. Another reception was held August 26 at the Hotel Roosevelt, New York, N. Y., for 200 foreign engineers brought here under the auspices of the Mutual Security Agency who were bound for Chicago to attend the Centennial.

A preliminary report of the second convention of the Pan-American Federation of Engineering Societies (UPADI), held in New Orleans, August 25–30, was prepared and circulated by S. E. Reimel, secretary of the convention. He reported that fourteen countries were represented at the convention which had

an attendance of 314. Because T. G. LeClair could be present only a short time during the convention, C. S. Proctor was made president and Luis Giannattasio was made honorary president. The next convention is scheduled for Sao Paulo, Brazil, in 1954.

The following three recommendations of the Committee on International Relations were approved by EJC:

1 That a special UPADI subcommittee of not more than five members be appointed by the chairman to become the working group and to develop and direct the continuing program of EJC relations with UPADI;

2 That EJC officially express its appreciation of the excellent work done by the local committee, under the general chairmanship of J. M. Todd, and the direct leadership of Lee H. ohnson;

3 That EJC urge Luis Giannattasio, president of UPADI, and F. Saturnino de Brito, filho, of the Brazilian Federation of Engineers, to take into consideration in connection with the date of the 1954 UPADI Convention the great desirability of co-ordinating this Convention with the meeting of the World Power Conference, scheduled for July 25-Aug. 8, 1954.

After a general discussion on UPADI, it was voted that EJC make a contribution of $500 to UPADI, and that the Committee on International Relations be requested to include in its next year's budget an appropriate contribution for the UPADI fund.

S. E. Reimel reported that the EJC reception for foreign engineers held at the Centennial was a success. Presidents and officers of engineering societies from all over the world attended the gathering.

National Science Foundation

Thorndike Saville, chairman, Committee on Engineering Sciences, reported that A. A. Potter, Purdue University, has been appointed to succeed himself as a member of the National Science Foundation. This action was supported by EJC. He also reported that a Committee of Consultants to the Division of Mathematics and Engineering of the National Science Foundation has been appointed. The Committee includes Eric Walker, AIEE, Pennsylvania State College; W. L. Everitt, AIEE, University of Illinois; Thomas Sherwood, AIChE, Massachusetts Institute of Technology; Kurt F. Wendt, mechanical engineer, University of Wisconsin, and Thorndike Saville, ASCE, New York University.

World Power Conference

G. A. Hathaway, chairman, U. S. National Committee, reported that the meeting of International Executive Council of the World Power Conference held at the Centennial was very successful. The next meeting of the WPC Executive Committee will be held in Germany in 1953 just before or after the Third International Conference on Soil Mechanics and Foundations scheduled for August. A Plenary Session will be held in Paris in 1956. WPC has been invited to Canada in 1958 for a Sectional Meeting. The Committee on Large Dams has extended an invitation for a meeting just before or after the Canadian meeting.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th Street	84 East Randolph Street	100 Farnsworth Ave.	57 Post Street

Men Available[1]

Mechanical Engineer, 38, BS, ex-Lt. Col., U. S. Army, considerable experience senior technical administration positions at board level. Good knowledge L-PG and industrial gases, flair for getting results, especially new projects. British but now U.S. immigrant, seeks interesting position anywhere giving scope, drive, initiative, and leadership. Me-912.

Engineering Manager, many years' experience in the design, construction, and operation of industrial plants and mining properties, requiring a knowledge of mechanical, electrical, civil, and mining engineering. Have directed many men and engineers working on foregoing projects. Domestic and foreign experience. Available now. Me-913.

Mechanical Engineer, 37, BSME, 2½ years design and layout of mining machinery; 1½ years design and layout of chemical-plant materials-handling equipment; 10 years' practical machine-shop experience. Interested in development, design, or production tooling. Me-914.

Attorney-Engineer, 32, married, mechanical, licensed in Pennsylvania for both. Broad government and business experience, heavy in operation, maintenance, and manufacture of aeronautical equipment. Management consulting preferred, direct management second. Me-915.

Electrical-Mechanical Engineer, first-paper citizen, speaks fluent English. Educated Glasgow University. 18 years' foreign utility and power-plant experience. Boilers, turboalternators, transmission, distribution, utility business management. Married. Dependable. In New York mid-November. Me-916.

Manufacturing Executive, 37, BME, LLB. 14 years' diversified manufacturing and management experience in production, purchasing, industrial engineering, management, and patents in the field of appliances, aircraft, radio parts, and steel. Me-917.

Mechanical Engineer, 1950, 30, two years' aviation-service engineering experience, customer contact, and engineering liaison. Desires sales-engineering position. Prefers East or far West. Me-918.

Positions Available

Engineers. *(a)* Assistant project manager, at least eight years' design and specification experience with consulting engineering firm covering heating and air conditioning in large buildings. $6760–$7280. *(b)* Construction engineer, mechanical, at least five years' experience in field inspection covering plumbing, heating, and air conditioning. $4680–$6500. *(c)* Design draftsman to design and lay out heating, ventilating, and mechanical trades. $3900–$5200. New York, N. Y. Y-7648.

Engineers, either sufficient experience in the installation, repair, and maintenance of 16 and 35-mm motion-picture sound projects and theater equipment, or sufficient background in allied fields (electronics, radio, sound-amplifying systems, etc.) so that they can be trained for this work. Applicants with degrees in ME or EE, but no previous experience will be considered. Duration, two years. $5500. Overseas. Y-7652.

Chief Engineer, 35–45, at least five years' design and manufacturing engineering experience covering fractional-hp motors and synchros, to take charge of new department for progressive expanding organization. Company will pay fee and moving expenses. $10,000–$12,000, plus participation and pension plan. N. J. metropolitan area. Y-7655.

Junior Project Engineer on special project bonding aluminum to steel. Should have some background of experience in heat transfer, strength of materials, pattern, and mold studies, etc. Will make all outside contracts with customers. $6000. L. I., N. Y. Y-7657.

Product Engineer, preferably mechanical. Must have basic experience in hydraulic equipment such as valves, compressors, pumps, etc. Assignment will include study of field failures, changes in design, etc., for the improvement of products. Up to $7200. East. Y-7662-D-8004.

Plant Engineer, 35–50, for maintenance, layout, and installation of machinery and equipment for large manufacturing plant including industrial power station and all facilities. Background in automotive or metal-cutting industrials desirable. $12,000–$14,000. Conn. Y-7667.

Process Engineer, young, two to five years' experience in machine-shop, metal-cutting, or automotive industry. Company manufactures airplane engines. $5400–$6500. Conn. Y-7668.

Sales Engineer, young, mechanical graduate, equipment-sales experience, to sell brakes and other sheet-metal processing machinery in New England and East. $5000–$6000, plus expenses. Headquarters, New York, N. Y. Y-7679.

Design Engineer, several years' experience in the field of unit heaters employing steam, hot water, and gas. Should be capable of directing and supervising design projects involving this product. $8000–$10,000. New York State. Y-7687.

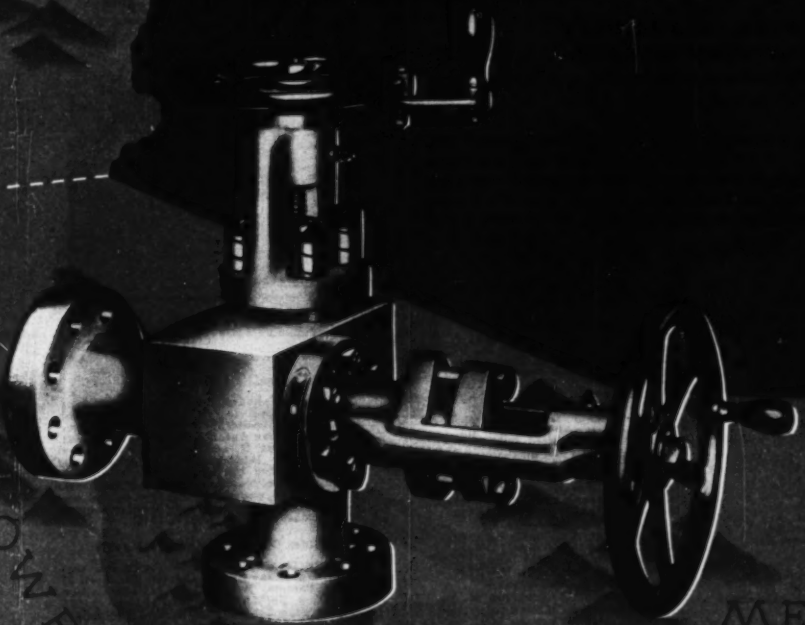
Designing and Estimating Engineer, degree in mechanical or general engineering preferred, or degree in civil, structural, or chemical engineering, adequate textile experience acceptable, minimum of five years' experience in textile industry, experience relative to textile finishing and process instrumentation. Will supervise the work of engineers in planning and costing and plan machinery or equipment layouts, draw up engineering specifications, supervise preparation of working drawings, and prepare estimates of labor and material costs on engineering projects. $5512–$6240. Va. Y-7689.

Sales Engineer, 25–35, BS in engineering, business administration helpful, two to six years' experience, to handle sales-control system (Kardex); preparation and clearance of mechanical division proposals, sales forecasting, sales statistics, market research and analysis, pricing problems and price lists, and analysis of territorial potentials. Liaison with New York, St. Louis, Chicago,

(ASME News continued on page 956)

[1] All men listed hold some form of ASME membership.

YARWAY UNIT TANDEMS



YARWAY SERVICE GOES ALL THE WAY....

Mexico City offices. Acquaintance with foreign distributor channels helpful. Headquarters, Mass. Y-7660.

Technical Writer, young, mechanical or chemical graduate, experience in process and equipment fields covering journalism, engineering, and marketing. Some traveling. $5500–$6000. New York, N. Y. Y-7693.

Engineer, experience in sheet metal for manufacturer of stall showers, cabinets, etc.; must have design ability for the development of new products. Experience in sheet-metal-equipment methods used in shop, etc. Must know tooling, jigs, etc. $8000. Newark, N. J. Y-7697.

Industrial Engineer, considerable materials-handling and wage-incentive experience. Aptitude and intelligence tests required. Mostly out-of-town work with some traveling. $8000–$10,000. Headquarters, New York, N. Y. Y-7698.

Design Engineer, 30–40, graduate in engineering or science, about ten years' design experience in metalworking manufacturing, including both product and tool design. After training for about a year, will be responsible for the following: review requests for applications of standard product and recommend applications, supervise design of variations of standard products; review inquiries for special products, carry out product design and development projects, supervise tool-design projects, do manufacturing research involving new factory methods, etc. Should have at least five years' board experience, thorough knowledge of drafting-room practices and techniques, thorough knowledge of tool design in heavy-metal stamping and production machining. $8000–$10,000. Pa. Y-7700.

Design Engineers, graduates, several years' experience in mechanical design, chemical or electrical engineers with considerable mechanical experience or ability will be considered, experienced on meters, valves, or control equipment preferred. Must be able to take a project from the beginning and carry it through to the point where it is successfully in production. Must have some possibilities of developing into a supervisory capacity. Must be prepared to locate in any of the various divisions of the company. Salaries open. Headquarters, Pa. Y-7701.

Associate or Assistant Professor, mechanical engineer, to teach machine-tool theory and practice and have charge of research in modern well-equipped laboratory. Immediate opening or in February, 1953. $4000–$7000, nine months. Mo. T-9255.

Project Engineer, mechanical, up to 45, three years' experience in project work on fast-moving machinery such as packaging or paper-folding equipment. Knowledge of printing helpful. Will do project work in maintenance, design, and installation of very fast-moving, light automatic machinery for a manufacturer. Up to $8840. Company will negotiate placement fee. Ill. R-9230[2]

Development Engineer, 40–55, mechanical or electrical, five years' experience developing and processing mechanical phases of high-voltage switchgear. Knowledge of manufacturing operations on stampings or castings. Design, develop, and process through manufacturing electrical high-voltage switchgear. Will also have to do own board work and should be creative or inventive-minded for a manufacturer of electrical equipment. Company will pay placement fee. $10,000. Ill. R-9262(*a*).

Sales Engineering Trainee, mechanical, good scholastic record and potentialities, to develop into sales engineer; familiarity with boiler rooms or steam plants desirable. Will spend six months in plant training and two years in sales office, and two years in contract engineering for a steam-instrument manufacturing company. $3600–$3900. Company may help on placement fee. Ill. R-9263.

Associate Metallurgist or Metallurgical Engineer, BS in metallurgy, over 30, five years' experience in use of all types of welding equipment, metallurgical investigation of welding problems. Will do experimental and theoretical approach to welding research on nonferrous metals and alloys. $5680–$10,620. Ill. R-9275(*a*).

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Nov. 25, 1952, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Members, Associate, or Junior

ALEXANDER, ROBERT E., Cambridge, Mass.
APOIAN, HARRY, Villanova, Pa.
BARTHLOW, THOMAS J., Buffalo, N. Y.
BEAN, HARRY P., Oakmont, Pa.
BEIN, DONALD H., Milwaukee, Wis.
BERNHARD, RICHARD A., South Euclid, Ohio
BITZER, GOTTLOB, Reading, Pa.
BLAIR, NEIL M., Deerfield, Ill.
BRADLEY, LEWIS R., Niagara Falls, N. Y.
BRUSH, DON O., Long Beach, Calif.
CARROLL, ALF L., Scarsdale, N. Y.
CASE, EUGENE M., Waterloo, Iowa
CELESTE, MICHAEL J., Newark, N. J.
CHENOGGES, JAMES L., Detroit, Mich.
COMERFORD, WILBUR J., Newark, N. J.
CONNELL, GILBERT F., Berkley, Mich.
COOPER, LESTER H., Alliance, Ohio
D'ARCY, ROBERT W., Arcadia, Calif.
DICK, WILLIAM P., Charleston, West Va.
DISMUKES, DOUGLAS E., JR., Hatboro, Pa.
DOBY, GEORGE F., Union, N. J.
DONLEY, JOSEPH L., Emmaus, Pa.
DUCKWORTH, WILLIAM P., Philadelphia, Pa.
DYKES, WILLIAM E., Houston, Texas
EISENHAUER, LAWRENCE H., JR., Poughkeepsei' N. Y.
FAHEY, BERNARD F., JR., Houston, Texas
FAULKNER, ROBERT G., Lansdowne, Pa.
FINEBLUM, SOLOMAN S., San Diego, Calif.
FISCHER, DAVID J., Chicago, Ill.
FITE, RALPH D., Seattle, Wash.
FOSTER, JAMES A., JR., Elkhart, Ind.
GIACOBBE, JOHN B., Norristown, Pa.
GIBBONS, JAMES A., Army Chemical Center, Md.
GILL, JOSEPH P., Lenoir City, Tenn.
GIMPEL, JOHN P., New York, N. Y.
GORCZYCA, JOSEPH J., Troy, N. Y.
GRABOW, WILLIAM D., Milwaukee, Wis.
GRIFFIN, LAWRENCE C., Toledo, Ohio
HABY, GEORGE H., Los Angeles, Calif.
HAISS, GUNTHER W., Alliance, Ohio
HARDING, GERALD B., JR., Freeport, Texas
HARTWICK, GEORGE J., Waukegan, Ill.
HERZ, JOSEF H., Kankesanturai, Ceylon
HERRICK, JOHN C., Los Angeles, Calif.
HOAD, JOHN G., Ann Arbor, Mich.
HORLDT, HENRY B., JR., Detroit, Mich.
HOSFORD, WILLIAM, Corpus Christi, Texas
JAWORSKI, WLADYSLAW, London, England
JENS, WAYNE H., Elmhurst, Ill.
JOHANSON HENRY O., Tulsa, Okla.
JOHNSON, HAROLD A., Warren, Pa.
KALDENBERG, HENRY J., Charles City, Iowa
KAMP, CARL M., East Peoria, Ill.
KARPEN, JOSEPH E., Erie, Pa.
KEAR, GEORGE H., Edwardsville, Kan.
KENNY, THOMAS H., Navarre, Ohio
KERR, DOUGLAS L., Schenectady, N. Y.
KILLEEN, GERALD M., St. Louis, Mo.
KLOTTER, KARL, Stanford, Calif.
LAFRAMBOISE, GUY R., Binghamton, N. Y.
LAU, JOHANN, Detroit, Mich.
LINKOWSKI, DANIEL J., Buffalo, N. Y.
MAC RUM, SAMUEL H., JR., Wilmington, Del
MALLETTE, FREDERICK S., Shaker Heights, Ohio
MARKS, CHARLES H., Columbus, Ohio
MAY, CHARLES E., Louisville, Ky.
MCCALLUM, IAN A., Niagara Falls, Ont., Can.
MCCLURE, JACK, Chattanooga, Tenn.
MCGILL, HUGH T., Omaha, Neb.
MCLEOAD, IAN, Geneva, N. Y.
MERSON, MARTIN, Easton, Pa.
MILLER, ROBERT L., Charleston, W. Va.
MONTGOMERY, JOHN H., Freeport, Texas
NARASIMHA, SARMA, Durbha V. L., Orissa, India
NELSON, HARLAN W., Columbus, Ohio
NOALL, JOHN, Akron, Ohio
NULL, FRANCIS W., Alexandria, Va.
OLIVIER, CHARLES D., New Orleans, La.
PALEY, PETER N., New Milford, N. J.
PALMER, SIDNEY C., Pittsburgh, Pa.
PAUL, SHYAMA C., Howrah, West Bengal, India
PAULUS, JAMES D., Baltimore, Md.
PIERSON, THOMAS H., Corpus Christi, Texas
PROCTOR, ALBERT E., Wembley, England
QUAYLE, GEORGE T., JR., Ishpeming, Mich.
QUILLMAN, BARD, Wilmington, Del.
RASTETTER, JOHN J., Erie, Pa.
RAY, RUFUS, JR., Birmingham, Ala.
REBER, JOHN, JR., Lancaster, Pa.
REINSCHMIDT, CLARENCE B., Savannah, Ga.
RIEKE, KENNETH L., Turtle Creek, Pa.
RUTHERFORD, KENNETH S., Freeport, Texas
SAUNDERS, DONALD A., Vancouver, B. C., Can.
SCHMOTZER, J. F., JR., Cuyahoga Falls, Ohio
SCHULTZ, ROBERT M., Jersey City, N. J.
SEPPA, WILLIAM O., New York, N. Y.
SHANNON, JACK F., Cleveland, Ohio
SHIOMI, ROY Y., Los Angeles, Calif.
SIMPSON, RICHARD N., Rolla, Mo.
SMITH, JAMES M., JR., Richland, Wash.
SNYDER, FRANK L., Swarthmore, Pa.
SOHN, RAYMOND, Roxbury, Mass.
STANBRIDGE, CHARLES H., Port Elizabeth, So. Africa
STEINFELD, ROBERT C., Wilmington, Del.
STOCK, ALVIN L., Prospect Park, Pa.
STOHLMAN, DONALD G., Louisville, Ky.
STUART, WALTER P., JR., Saltville, Va.
STULGA, CHARLES D., Murray Hill, N. J.
SUMMERS, OLIVER W., New Augusta, Ind.
SWANSON, LESLIE T., Pottsville, Pa.
TAIT, GEORGE R., Bartlesville, Okla.
TAYLOR, CHARLES E., Washington, D. C.
TROLLER, JOHN E., Chicago, Ill.
UBWICK, LYNDALL, New York, N. Y.
VAN HECKE, GEORGE J., Detroit, Mich.
VISHWAKARMA, GANGAPRASAD D., Jabalpur, M. P., India
WAGNER, STANLEY T., Philadelphia, Pa.
WALKGIR, VICTOR, South San Francisco, Calif.
WASTIE, ARTHUR E., Westfield, N. J.
WEBSTER, JULIAN C., Buffalo, N. Y.
WESTMORELAND, LENDELL H., Corpus Christi, Texas
WORTELL, MARVIN, Chicago, Ill.
YANKO, LEONARD B., Newburgh, N. Y.
YEN, TSE GHU, New York, N. Y.

CHANGE IN GRADING

Transfers to Member and Associate

ALEXANDER, FINO F., Warren, Pa.
BERG-JOHNSEN, JOHN, JR., Pine Orchard, Conn.
BERKEY, DONALD C., Schenectady, N. Y.
BOER, ELMER J., Columbus, Ohio
BROWARD, HOYT E., Jacksonville, Fla.
CEHES, CHARLES H., Berkeley, Calif.
DOLCE, SEBASTIAN J., Elmhurst, L. I., N. Y.
DUCEY, JOHN F., JR., San Francisco, Calif.
GESSOW, IRVING D., Washington, D. C.
GOMPERTZ, RICHARD F., Edwards, Calif.
HART, DAVID K., Altadena, Calif.
JOHNSON, SIGURD O., Cincinnati, Ohio
KIMBRELL, JACK T., Overland Park, Kan.
KULJIAN, ARTHUR H., Ridley Park, Pa.
MCDONOUGH, JOHN T., Pittsburgh, Pa.
ORVIS, WARD C., Los Angeles, Calif.
SALVERSON, MELVIN E., Los Angeles, Calif.
SCHMID, BEN J., San Mateo, Calif.
SNYDER, RICHARD P., Clearwater, Fla.
THORNBURG, ROBERT W., Mound, Minn
WARREN, RAYMOND W., McLean, Va.

Transfer from Student Member to Junior 133

Obituaries

Herman Alamo Bartholomaei (1891–1951)

H. ALAMO BARTHOLOMAEI, staff assistant, management engineering and quality control, Bendix Radio, Towson, Md., died in October, 1951. Born, San Antonio, Texas, Nov. 26, 1891. Parents, Albert S. and Annie E. (Rawlings) Bartholomaei. Education, high-school graduate; attended Purdue University. Married in 1920 (divorced); son, Nathaniel T. Bartholomaei. He wrote several papers on quality control and various improvements he made in paper-converting machinery. Mem. ASME, 1944.

Elden Gunnard Carlson (1924–1952)

ELDEN G. CARLSON, junior mechanical engineer, Sargent and Lundy, Chicago, Ill., April 25, 1924. Parents, Joseph G. and Viola Carlson. Education, BS(ME), University of Illinois, 1945; evening school, Illinois Institute of Technology, 1946–1948. Married Ruth Antonson, 1949. Jun. ASME, 1947. Survived by wife and two

(*ASME News continued on page 958*)

15 YEARS LATER

Aerial view of Delaware River Bridge taken in the spring of 1952, showing the High Speed Rail Transit Lines on outer sides of bridge. Photo by Aero Service Corporation.

...a report on the service of Everdur Electrical Conduit on the Delaware River Bridge

The Delaware River Bridge, linking Camden, N. J. with Philadelphia, opened to vehicular traffic in July 1926. In 1934-36, when the High Speed Rail Transit Line was installed, more than 200,000 pounds, or 14½ miles of Everdur* Conduit, in nominal sizes from 1½" to 4", was used for electrification and electro-pneumatic signal operations.

Service conditions were anything but good—and the problems encountered included corrosive industrial gases and almost continual vibration caused by the rapid transit rail cars and 70,000 motor vehicles a day.

Now, with another bridge expansion project planned, an engineer of The American Brass Company made an "on-location" inspection of the 15-year-old installation. The detailed report concludes as follows:

> *"It is my opinion that the corrosion rate of the unpainted Everdur Conduit installed on the Delaware River Bridge is very low, and that the conduit will last as long as the bridge itself."*

Everdur Electrical Conduit is made of Everdur Copper-Silicon Alloy in two wall thicknesses (R.C. and E.M.T.). Publication E-12 describes this ANACONDA Product in detail. For a copy, address The American Brass Company, General Offices, Waterbury 20, Connecticut. SM48

*Reg. U.S. Pat. Off.

In 1936, at the time of installation, the Transit Line rails were utilized to transport 20-foot lengths of Everdur Conduit to the cable runways.

wherever corrosion resistance counts ***consider***

EVERDUR ELECTRICAL CONDUIT

a product of

ANACONDA®

children, Gary B., Glenn A.; and a sister, Mrs. Violet Erikson.

Howard Cooper (1890–1952)

HOWARD COOPER, manager of technical service, Lubricating Sales Division, Sinclair Refining Co., New York, N. Y., died June 27, 1952. Born, Chicago, Ill., Dec. 23, 1890. Parents, Albert G. and Mary E. (Shaw) Cooper. Education, BS(ME), Armour Institute of Technology, 1913. Married Gertrude D. Lyons, 1938. During World War II he was Petroleum Administration for War section chief in Marketing Division. Jun. ASME, 1917; Mem. ASME, 1945. He was a former president of the National Lubricating Grease Institute. Survived by wife.

Heinrich Hermann Meno Kammerhoff (1867–1952)

H. H. MENO KAMMERHOFF, who retired in 1930 from the Electric Storage Battery Co., Philadelphia, Pa., died Feb. 14, 1952. Born, Ratzburg, Germany, Nov. 5, 1867. Parents, Georg and Lisette Kammerhoff. Education, attended gymnasium in Germany for three years; studied inorganic chemistry at Temple University, 1926–1928. Naturalized U. S. citizen, Camden, N. J., Sept. 29, 1931. Married Julie von Verschuer, 1898, children, Egon, Käthe, Gertrude. He was the author of several papers and a book on batteries; held eight U. S. Patents pertaining to batteries; and after his retirement continued his research work in the electrical field. Mem. ASME, 1914.

Charles Francis Leonard (1876–1951)

CHARLES F. LEONARD, consulting engineer, New York, N. Y., died Nov. 29, 1951. Born, Worcester, Mass., April 22, 1876. Parents, Dennis C. and Margaret (Cunningham) Leonard. Education, BS(ME), Worcester Polytechnic Institute, 1896. Married Mary Ryan, 1909 (died 1952). Mem. ASME, 1913. Survived by brother, James R., and two sisters, Katherine and Alice M., all of Worcester, Mass.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult reverse side of card for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting your address, business connection, and Professional Divisions enrollment is printed on this page. Please use it to keep the master file up to date.

Four weeks are required to complete master-file changes.

ASME Master-File Information

(Not for use of student members)

Please print — Check mailing address

Name ..... (Last, First, Middle)

Home address ..... (Street, City, Zone, State) ☐

Name of employer .....

Address of employer ..... (Street, City, Zone, State) ☐

Product or service of company .....

Title of position held .....

Nature of work done .....

Please register me in three Professional Divisions as follows:

1 .....

2 .....

3 .....

(Processing of address change requires four weeks)

I am a subscriber to (please check)

Transactions ☐ Journal of Applied Mechanics ☐ Applied Mechanics Reviews ☐

Herbert Bump Lewis (1889–1952)

HERBERT B. LEWIS, marketing service engineer, market-development department, Lukens Steel Co., Coatesville, Pa., died Aug. 1, 1952. Born, Bridgeport, Conn., Jan. 16, 1889. Education, graduate, Rensselaer Polytechnic Institute, 1914. At the beginning of World War II he took charge of aircraft-brake research and development for the National Research Council; later he served as executive secretary of the Manufacturing Engineering Committee, ASME. This committee was operated under the War Production Board to supervise research and development on design, processes, and methods to increase the effectiveness of the war effort. Assoc-Mem. ASME, 1925; Mem. ASME, 1928. He served the Society as member, ASME Metals Engineering Handbook Board and chairman of its Advisory Committee; member, Advisory Committee, Production Engineering Division; and chairman, Technical Committee #24 on Carbide Tipped Milling Cutter Bodies of ASA Sectional Committee B5 on Small Tools and Machine Tool Elements. He was coauthor of the ASME paper, "Ruling Line Standards." Survived by wife; a son, Herbert F.; and a daughter, Mrs. James H. Chapman.

Wayland Everett Loomis (1912–1952)

WAYLAND E. LOOMIS, design engineer, The American Hardware Corp., New Britain, Conn., died Aug. 5, 1952. Born, Schenectady, N. Y., Dec. 29, 1912. Parents, Everett E. Loomis (deceased) and Myra (Manwaring) Loomis (Mrs. Ira) Barnard. Education BS(ME), North Carolina State College, 1937. Married Elizabeth Wing, 1944. Jun. ASME, 1937; Mem. ASME, 1948. Survived by wife and two sons, Wayland E., Jr., Warren D.; and mother.

Edward Godfrey Miller (1885–1951)

EDWARD G. MILLER, president, Compañia Azucarera Atlantica del Golfo, Havana, Cuba, died in September, 1951, while on vacation in France. Born, New Orleans, La., Feb. 3, 1885. Parents, William P. and Elizabeth (Murray) Miller. Education, high-school graduate, New Orleans, La. Married Nora Elizardi, 1907, children, Elizabeth (Mrs. Harold W.) Knight, Edward G., Jr., John E., Margaret P. Assoc-Mem. ASME, 1913; Mem. ASME, 1935.

Henry Frederic Norden (1890–1952)

HENRY F. NORDEN, retired marine engineer, Foreign Repairs and Salvage Division, War Shipping Administration, Washington, D. C., died April 27, 1952. Born, New York, N. Y., Sept. 11, 1890. Parents, Henry E. and Mary Helen (Buck) Norden. Education, ME, Stevens Institute of Technology, 1916; Business Law, College of William and Mary. Jun. ASME, 1920; Assoc-Mem ASME, 1924; Mem. ASME, 1930. Survived by mother, and sister, M. Augusta.

Alfred George Norris (1890–1952)

ALFRED G. NORRIS consulting research engineer, Berkeley, Calif., died at Permanante Hospital in Oakland a few months ago according to a report received by the Society. Born, Jersey City, N. J., April 18, 1890. Parents, Albert and Mary (Evans) Norris. Education, attended Stevens Institute of Technology; LL.B, Lincoln-Jefferson University, 1914. Married Lillian E. Lieber, 1916 (divorced 1946); daughter, Mrs. Polly N. Bills. Mem. ASME, 1945.

Paul Frederick Nydegger (1875–1925)

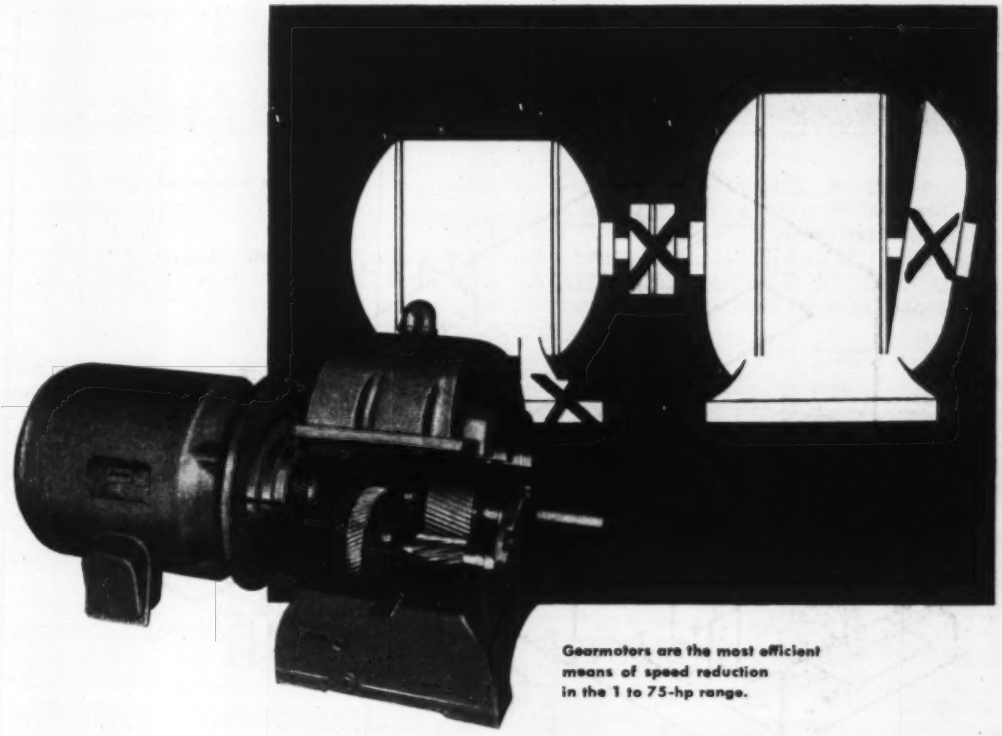
PAUL F. NYDEGGER, engineering consultant, Westfield, N. J., died at Truckee, Calif., Aug. 10, 1952. Born, Duanne A. Berne, Switzerland, July 31, 1875. Parents, Frederick and Matilda (Gerster) Nydegger. Education, BS, Cooper Union Institute, 1904; ME, 1912. Naturalized U. S. citizen. Married Paula Momm, 1901. Mem. ASME, 1921. Survived by wife and three children, Ellen (Mrs. Colby W.) Bryden, Hazel J., Roland R.; and three grandchildren.

Ralph Fred Swanson (1926–1952?)

RALPH F. SWANSON, whose death was recently reported to the Society was a mechanical engineer, Rauland Corp., Chicago, Ill., Born, Chicago, Ill., Aug. 8, 1926. Education, BS(ME), University of Illinois, 1951. Jun. ASME, 1951.

Clyde Thompson (1893–1952)

CLYDE THOMPSON, mechanical engineer, research department, Atlantic Coast Fisheries Co., New York, died July 30, 1952. Born, Joppa, Ill., July 12, 1893. Education, attended public schools. Jun. ASME, 1919; Assoc-Mem. ASME, 1923; Mem. ASME, 1935. Survived by wife, Katherine M. Thompson.



Gearmotors are the most efficient means of speed reduction in the 1 to 75-hp range.

Here's why Life-Line GEARMOTORS stay on the job longer

LESS TIME OUT FOR SERVICING MOTOR

Removing the motor from a Life-Line gearmotor takes but a few minutes. Remove the motor mounting bolts and you are on your way—and, reassembly is just as simple and fast. Install the mounting bolts and the job's complete. No realigning of shafts—no coupling to adjust—no mounting feet to shim.

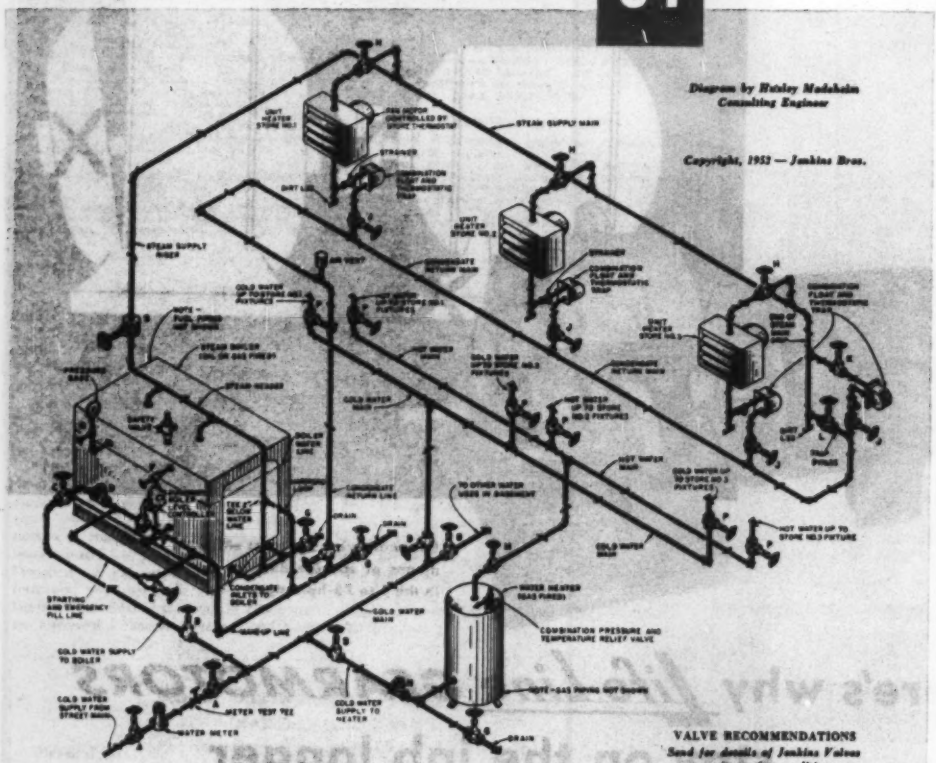
Should you be "on the spot" where down time is critical, this means that your spare motor can be quickly and easily installed. At the most, it is a simple assembly of the adapter bracket.

LESS TIME OUT FOR SERVICING GEARS

Here again, Life-Line's split case construction pays off. Simply by removing the top half of the gear case, the gears can be inspected or removed without touching the mounting bolts—without draining the oil—without disturbing the connected load.

Ask your Westinghouse representative for the details on how Life-Line gearmotors pay for themselves in production time saved. For descriptive literature, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-07313

JENKINS PRACTICAL PIPING LAYOUTS 64



Code	Quan.	Jenkins Valve	Service
A	2	Fig. 370 Bronze Gate	Water Service Shutoff
B	4	Fig. 370 Bronze Gate	Distribution Shutoff
C	1	Fig. 106-A Bronze Globe	Water Supply to Boiler
D	1	Fig. 92 Bronze Swing Check	Prevent Boiler Backflow
E	1	Fig. 108-A Bronze Angle	Emergency Boiler Fill
F	2	Fig. 108-A Bronze Angle	Level Controller Shutoff
G	3	Fig. 106-A Bronze Globe	Drains Shutoff
H	3	Fig. 106-A Bronze Globe	Steam Supply to Heaters
J	4	Fig. 370 Bronze Gate	Condensate Drain Shutoffs
K	1	Fig. 106-A Bronze Globe	Steam Main Trap Connection
L	1	Fig. 106-A Bronze Globe	Trap Bypass
M	1	Fig. 47-U Bronze Gate	Hot Water Heater Shutoff
N	1	Fig. 92 Bronze Swing Check	Prevent Water Heater Backflow
P	6	Fig. 370 Bronze Gate	Water Supply Shutoffs
R	1	Fig. 743-G Bronze Needle	Pressure Gage Control
S	1	Fig. 651 I.B.B.M. Gate	Steam Main Shutoff
T	1	Fig. 370 Bronze Gate	Return Shutoff

How to plan PLUMBING AND HEATING IN A SMALL TAXPAYER BUILDING

The one-story "taxpayer" building developed with the movement of shopping centers to suburban areas. Constructed with or without a basement, it houses retail stores, service establishments, amusement centers, restaurants and offices.

Heating and plumbing requirements of such a building are usually provided by the owner, whose main interest is economy and trouble-free operation. An oil or gas fired steam boiler with automatic controls, and a separate gas fired heater for hot water supply, as illustrated, is commonly used.

The two-pipe heating system, located in the basement, utilizes unit heaters hung from the ceiling to save space. Individual thermostatic controls assure fuel savings and even heating. A further refinement of the control system would include an automatic shutoff or modulator valve on the steam line just ahead of each heater, and an aquastat in the condensate return line from each heater. Piping is simple in such an installation and standard-type valves are used.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation.

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the complete Jenkins line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17.

Complete description and enlarged diagram of this layout free on request. Includes additional detailed information. Simply ask for Piping Layout No. 64.

JENKINS VALVES
LOOK FOR THE DIAMOND MARK
SINCE 1864

Those in industry who are responsible for various phases of plant, machinery, and product design, production, operating and application engineering will find much to interest them in this Buyer's Catalog Guide. Here, reputable manufacturers, most of whom have current advertising in MECHANICAL ENGINEERING and ASME MECHANICAL CATALOG AND DIRECTORY, offer to send you without obligation, their latest literature which is described on pages 45 to 82. Make use of the coupon on page 44.

Catalog Index By Products

Adhesives, Industrial 187
Adjustable Speed Drives 108
Aerostor Unit 382
Air Conditioners 298, 312, 379
Air Cylinders 22, 130
Air Handling 312, 379
Air Hoists 58
Air Valves 238
Aluminum, Extruded 227
Armoring 18
Ash Handling Systems 270
Atomizers 408

Bearings 1
Bearings, Aircraft Control 195
Bearings, Ball 33, 191, 210, 303
Bearings, Conveyer Roll 109
Bearings, Miniature Ball 98
Bearings, Mounting and Removal 20
Bearings, Nylon Lined 125
Bearings, Roller 244, 255, 303
Bimetal, Thermostatic 205
Blast Cleaning 354
Blowers 26, 36, 69, 73, 116, 305
Boiler-Water Columns 288
Boilers 21, 27, 29, 42, 80, 169, 172, 194, 213, 226, 299, 370, 386
Boilers, Gas-Fired 29
Boilers, Packaged 27, 226, 281
Boilers, Power 213
Boilers, Self-Contained 370
Boilers, Test 325
Boilers, Water Tube 172, 213
Boring Machines 398
Brakes, Electric 283
Bronze, Bearing 178
Bronze Casting Alloys 5
Bucket Elevators 199

Cameras, High Speed 6
Carbide, Cemented 225
Cements, Iron 112
Chain Drives 54, 290
Chains 1
Chains, Roller 54, 63, 158, 177
Chucks 117
Clutches, Electric 283
Coatings, Protective 72, 146, 252
Coils, Cooling 318
Cold Forming 301
Cold Roll Forming Equipment 46
Compressors 2, 294, 331
Compressors, Centrifugal 201, 302
Compressors, High-Pressure 300
Computers, Analog 123
Computers, Military 93
Condensafilter 87
Containers, Shipping 254
Controllers, Automatic 228
Controls, Automatic 17, 409
Controls, Gunfire 93
Controls, Motor Speed 97
Controls, Remote 168
Convector Radiation 207
Conveyer Systems 141
Conveyers 54, 82, 196, 199, 231, 253
Conveyers, Ash 28
Conveyers, Fly-Ash 28
Conveyers, Oscillating 184
Conveyers, Roller 297
Cooling Tower Equipment 183
Cooling Towers 242, 312, 327
Copper 75, 347
Copper Alloys 75, 347
Copying Equipment 102
Counters, Recording Mechanical 216
Couplings 1, 76, 392
Couplings, Flexible 79, 278, 286, 378
Crane Trucks 401
Crushers 99, 199, 211
Cups, Molded 271
Cutouts, Overload 352
Cutting Fluids 114
Cylinders, Air 22, 130
Cylinders, Hydraulic 311

Deaerator, Vacuum 247
Demineralizer 156
Dies 111
Disks 343
Dispatch Systems 48
Distributors, Coal 304
Doors, Rolling 385
Dowel Pins 364
Downspouts 74
Drafting-Machine Scales 249
Drafting Machines 16
Drafting-Room Equipment 3, 16, 45, 66, 77, 200, 204
Drawing Pencils 66, 77
Dust Collection 40, 379
Dust Collectors 100, 110, 262, 291, 326, 379
Dust Control 176, 262, 354, 379

Electric Products 65
Electric Radiant Panels 85
Electrical Machinery 118
Elevators 316
Evaporators 90
Exhausters 69

Fabrication, Alloy Plate 154
Fabrication, Steel 154
Fans 73, 116
Fans, Axial-Flow 26
Fans, Forced-Draft 36
Fans, Induced-Draft 36
Fans, Ventilating 372
Fasteners 41, 43, 135
Feeders 109
Feedwater Heaters 90
Fiberglas Structural Panels 361
Filters, Compressed Air 87, 245, 306
Filters, Oil 265
Filters, Separators 245
Filtration Data 101
Fintubes 257
Fittings 86, 246
Flanges 92, 246
Flangettes 92
Flexible Metal Hose 360
Flexible Shaft Couplings 76
Flexible Shaft Power Drives 91
Flexible Shafting 106
Flooring 50, 95
Flooring, Steel 18
Flow Signal Transmitter 84
Flowmeters 57, 148, 366
Fluid Power Equipment 32
Flyash Collection 326
Fly-Ash Collectors 100
Force-Measuring Device 142
Forgings 121
Forgings, Drop 185
Fork Truck Operation 210
Fume Collectors 110
Furnaces 21, 124, 397

Gages 67
Gages, Draft 35
Gages, Pressure 339
Gages, Water 239, 404
Galvanizing 337
Gas Burners 287
Gases, Liquefied 192
Gaskets, Spiral-Wound 319
Gear Drives 152
Gearing 152
Gearmotors 264
Gears 1, 345, 349
Gears, Plastic 193
Gears, Worm 224
Glucosates 315
Graphalloy Products 388
Grating 18, 50, 95
Grouting 383
Gutters 74

Heat Exchangers 62, 90, 275, 358
Heat Transfer 342
Heat-Transfer Equipment 151
Heat Treating Furnaces 124
Heaters 9, 14, 94, 370
Heaters, Direct-Fired 25, 52, 289
Heaters, Electric 85, 104
Heaters, Induction 150
Heaters, Space 25, 52, 289
Hose 330, 338

Indicator, Bin Level 206
Industrial Instruments 4, 23, 212, 228, 243, 259, 373
Instrument Test Stands 182
Instruments 147, 259
Instruments, Speed-Measuring 243
Insulating Materials 329
Insulation 252
Ion Exchangers 166

Joints 236, 241
Joints, Expansion 167, 179

Lapping 132
Linkages 54
Locknuts 335
Lubricants 353
Lubrication 51, 83, 285

Manometers 314
Marking Tools 400
Materials-Handling Equipment 28, 48, 61, 82, 141, 184, 196, 199, 219, 231, 253, 270, 297, 320, 367, 401
Measuring Instruments, Electrical 147
Metal Bending 11
Metal-Forming 341
Metalworking Machines 174, 394, 398
Meter Selection 4
Meters 4, 57, 69, 373
Meters, Liquid 23, 107

Microhoning 374
Motion-Picture Cameras 6
Motodrive, Vari-Speed 218
Motors, Air 22
Motors, Electric 115, 136, 144, 181, 186, 299, 357
Motors, Hydraulic 296, 387
Motors, Shaded Pole 407
Motors, Turbine Pump 214
Motors, Worm Gear 186

Nickel Alloy 126
Nozzles 408

O-Rings 215
Oil Burners 10, 30, 56, 287, 389, 396, 402
Oil Filters 161
Oil-Gas Burners 10
Oil Mist Precipitators 375
Oil Power Equipment, Hydraulic 134
Oiling Devices 161, 265
Ovens, Electric 104
Oxygen Production 128

Pencils 200, 204
Pipe 153
Pipe, Cement-Lined 202
Pipe Fittings 234
Pipe Hangers 53
Pipe, Wrought Iron 49
Piping Design 164
Piping Erection 170
Piping Fabrication 170
Piston Rings 371
Plant Construction 308
Plant Layout 362
Plate Fabrication 358
Plates 343
Plugs 364
Pneumatic Positioners 355
Power Equipment 32
Power Products Directory 34
Power Supplies 250
Power Transmission Equipment 223
Precipitators 375
Precipitators, Electrostatic 232
Presses, Metal-Working 394
Pressure Vessels 309
Protective Coatings 146, 252
Pulleys 1
Pulverizers 99
Pumps 10, 13, 69, 157, 292, 296, 350, 359, 363
Pumps, Centrifugal 13, 113
Pumps, Chemical 266
Pumps, Compressor 346
Pumps, Constant Delivery 190
Pumps, Coolant 39
Pumps, Horizontal End Suction 284
Pumps, Hydraulic 96, 296, 387
Pumps, Hydraulic Lubricant 83
Pumps, Rotex 31
Pumps, Screw 31
Pumps, Sump 180
Pumps, Vacuum 346
Punches 111
Purifiers 103

Continued on Page 44

Use Coupon on Page 44

Quenching Oils 353

Ratiometers 1
Recorders 259
Refractories 15, 395
Regulators 280, 409
Regulators, Feedwater 240
Regulators, Flow 165
Regulators, Pressure 217, 221, 230, 403, 409
Regulators, Temperature 217, 221, 239
Research Apparatus 313
Rings, Retaining 235
Rolled Steel Products 380
Rubber, Cellular 163
Rubber Mildew 295

SK Equipment 64
Safety Treads 95
Seals 237, 274, 344
Seals, Mechanical 317
Separator-Filters 306
Separators 292
Separators, Magnetic 393
Separators, Steam 78
Sheet, Stainless-Steel 143
Sicromatic Charts 310
Silicone Products 105
Silos 199
Skip Hoists 199
Snubbers, Air Line 282
Snubbers, Gas 282
Snubbers, Slug Buster 293
Socket, Screws 364
Solenoids, Rotary 307

Soot Blowers 122, 131
Speed Measuring Devices 88
Speed Reducers 1, 55, 108, 129, 138, 160, 260, 328, 349
Springs, Mechanical 333
Sprockets 1, 63, 177
Stainless Steel Fabrication 74, 229
Stair Treads 50
Steam Engines 384
Steam Generators 21, 27, 29, 42, 80, 169, 172, 194, 213, 226, 299, 370, 386
Steam Generators, Packaged 27, 169, 226, 281
Steam Products 65
Steam Trap Book 208
Steam Trap Problems 273
Steam Traps 197
Steel Properties 277

Steel, Titanium Alloy 70
Steels 119, 137
Steels, High-Speed 173, 277
Steels, High-Temperature 68
Steels, Specialty 59
Steels, Tool Die 59, 277
Stokers 80, 287
Stokers, Automatic Underfed 80
Stokers, Centrafire 71
Stokers, Chain-Grate 391
Stokers, Spreader 24, 279, 377
Strainers 81, 161, 239
Strainers, Pipe Line 81
Strip, Stainless 143
Surface Roughness 334
Swivel Joints, Ball Bearing 38

Tachometers 88
Tanks 248, 256, 276
Technical Books 44, 258, 405
Templets 8
Thermistors 67
Thermometers 67
Thermostats 139
Thread Inserts 351
Titanium Alloy 70
Tool Steels 119, 173
Torque Converters, Hydraulic 322
Towers 248
Transmitters, Flow Signal 84
Transport System, Pneumatic 320
Tube Cleaners 65, 399
Tube Expanders 399
Tube Fittings 86
Tube-Supported Walls 140
Tubes 153
Tubes, Flow 406
Tubing 19
Tubing, Welded Mechanical 261
Turbines, General Purpose 233
Turbines, Hydraulic 127
Turbines, Steam 65, 272
Turning Machines 398

V-Belt Drives 321
Valves 7, 12, 89, 120, 137, 145, 155, 171, 188, 189, 230, 234, 239, 263, 280, 324, 332, 340, 343, 348, 369, 376, 406, 409
Valves, Boiler 60
Valves, Corrosion Resistant 263
Valves, Explosionproof Air 238
Valves, Pressure-Seal 332
Valves, Solenoid 37, 155, 203, 239
Vaporizers 14, 381
Variable Speed Drives 220, 268
Vibration Control 133
Vibration Control Systems 251
Vibratory Equipment 61

Water Hammer 171
Water Heaters, Gas 336
Water Problems 175
Water Surface Selection 222
Water-Treating Equipment 267
Water Treatment 162, 175
Water Vapor Physics 149
Weighing Equipment, Automatic Conveyer 47
Weighing Machines 159, 188, 300
Welded Steel Products 380
Welding 198, 269, 368
Weldments 269, 380
Wire 323
Work Benches 356

Mail This COUPON Today

MECHANICAL ENGINEERING, 29 West 39th St., New York 18, N. Y.

Date.....

Please send me without cost or obligation the literature indicated by the following circled numbers which appear in "BUYER'S CATALOG GUIDE" in the November 1952 issue.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165
166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195
196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225
226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255
256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
271	272	273	274	275	276	277	278	279	280	281	282	283	284	285
286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
301	302	303	304	305	306	307	308	309	310	311	312	313	314	315
316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
331	332	333	334	335	336	337	338	339	340	341	342	343	344	345
346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375
376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
391	392	393	394	395	396	397	398	399	400	401	402	403	404	405
406	407	408	409											

DISTRIBUTION BY US TO STUDENTS NOT INCLUDED

To receive literature requested—*Firm Connection and Occupation Must Be Given*

Name.....

Position.....

Company.....

Address.....

PLEASE CHECK
☐ ASME Member
☐ Non-Member

11-52

NOT GOOD IF MAILED AFTER DECEMBER 15, 1952

(Foreign Requests may be Mailed up to December 24, 1952)

Read the various items listed... one catalog may hold the solution to your present problem...

diacro
"it's easy to bend"
a new practical 32 Page
diacro
BENDING MANUAL
by the originators of "Die-less Duplicating"
This instructive and authoritative booklet will quickly prove itself indispensable wherever bending is done or is needed. It brings you a veritable gold mine of tested, authentic bending methods applicable to any rotary type bender. The proper bending technique may frequently offer a new approach to an old problem by simplifying product design and cutting production costs.
The exact methods of producing various types of bends in a wide range of materials are illustrated, step by step, with over 90 diagrams and charts together with valuable tooling suggestions.
You'll want a copy . . . .
Mail your request today.
DIACRO
DIE-LESS DUPLICATING
O'NEIL-IRWIN
308 8th Ave.
Lake City, Minn.
NOTCHERS
PUNCHES
BENDERS
BRAKES
ROLLERS
SHEARS
ROD FORMERS

1 GEARS, ETC.

Boston Gear Works.—Catalog No. 55 gives complete information and prices on over 4500 stock items including spur, miter, bevel, helical, and worm gears, roller chains, sprockets, ball bearings, pillow blocks, couplings, pulleys, speed reducers, fationmotors, and oil-impregnated porous bronze bearings. It provides engineering data, formulas, horsepower rating charts, reference tables, and selection charts for figuring the correct power drive and selecting the proper equipment for virtually every mechanical power transmission.

2 OILFREAIR COMPRESSORS

Pennsylvania Pump & Compressor Co.—New Oilfreair compressor design is described in bulletin No. 600. This Oilfreair compressor employs a steel-backed carbon cylinder liner in the air cylinder which requires no lubrication whatsoever and the machine is guaranteed to provide air or gas entirely free of oil or oily vapors.

3 LETTERING MACHINE

Ralph C. Coxhead Corp.—Bulletin tells how Vari-Typer lettering machine offers fast method of lettering bills of material, notes, specifications on tracings and drawings, and countless other drafting-room lettering details. A few of the many styles of instantly changeable type are illustrated.

4 INDUSTRIAL METER SELECTION

Rockwell Mfg. Co.—A new bulletin, No. OG-400, intended to guide the proper selection of meters for measuring more than 200 chemicals, petroleum products, and other liquids with varying corrosive characteristics is available. In addition to the complete table of metered liquids matched with case, chamber, and piston specifications, the bulletin also includes a simplified specification sheet which makes it easy for the customer to cover all necessary operating requirements so that proper meter recommendations can be made at the factory.

5 BRONZE CASTING ALLOYS

American Manganese Bronze Co.—50-page edition of the "Reference Book on Bronze Casting Alloys" gives general information on composition, characteristics, and applications of many of the common or typical alloys. The book will help the engineer or designer in the selection of the right alloys for any general application.

6 HIGH-SPEED MOTION-PICTURE CAMERAS

Wollensak Optical Co.—Applications, characteristics, and accessories of the Fastax, a high-speed motion-picture camera are given in a new 12 page booklet.

7 STEEL VALVES

Wm. Powell Co.—Catalog No. 102 summarizes the broad line of Powell cast-steel valves. Included are bolted flanged bonnet valves, class 150 lb to class 2500 lb inclusive, and pressure seal valves, classes 600, 900, 1500, 2500 lb and higher. Containing more than 200 pages, the bulletin discusses the production facilities at Powell, the engineering service, large stocks in principal cities of the United States, vigilant laboratory control of metal heats, the chemical and physical properties of the various Powell cast steels, and specification data on each of a wide variety of valve classes.

8 TEMPLET FILING PLAN

Repro-Templets Inc.—A Booklet, "The Master Planning File of Repro-Templets on Film," has been compiled and edited for the express purpose of providing the plant layout engineer with a basic file of machine and equipment templets in 1/4-in. scale, thus eliminating the costly and time-consuming job of making original scale templet drawings for reproduction.

9 UNIT HEATERS

Grinnell Co.—Catalog UH-1950 illustrates and describes horizontal and vertical delivery and textile types of Grinnell Thermoliers. Textile type self-cleaning for use in dusty, lint, and fly-laden atmospheres. Complete capacities, dimensions, weights, motors, wiring diagrams, piping connections, and methods of suspension. Exclusive features described and illustrated.

10 OIL AND OIL-GAS BURNERS

Petro.—New 20-page catalog 3048 covers all types and sizes of Petro commercial-industrial rotary cup oil burners, combination oil-gas burners, and multi-belt-driven pumps for heavy industrial oils. Includes illustrations, descriptions, detailed construction features, wiring and piping diagrams, burner rating tables, and data on controls.

11 METAL BENDING

O'Neil-Irwin Mfg. Co.—New 32-page bending manual contains information on a wide variety of forming operations. The bending of tubing, angle, channel, extrusions as well as solid materials is graphically illustrated. Detailed prints show the exact manner in which any rotary-type bending machine can be tooled for precision bending. The manual outlines the recommended steps in designing parts to be formed, choice of materials, and selection of bending equipment.

12 LUBRICATED PLUG VALVES

Homestead Valve Mfg. Co.—Reference Book 39-5 contains complete information on the expanded Homestead-Reiser lubricated plug valve line. Catalog includes valve cross-sectional views, photographs, dimensions, and information for ordering. In addition, complete specifications are given for the new venturi-type, worm-and-gear controlled, steam-jacketed bonnet, and three-wave valves, all recently added to the line.

13 CENTRIFUGAL PUMPS

Deming Co.—Bulletin No. 4012-A describes and illustrates the single stage, side-suction, two ball-bearing-type centrifugal pump. Made in sizes 1 to 10 in. discharge with capacities 10 to 3600 gpm. Details of construction and performance tables for both motor or belt-driven pumps are included.

14 DOWTHERM VAPORIZERS THERMAL LIQUID HEATERS

International Boiler Works Co.—Catalog and Specification sheet describe International-LaMont thermal liquid heaters type LCF and Dowtherm vaporizers, Type LCD. For process temperatures to 750 F in the Chemical and Process industries. Units are completely packaged including oil or gas burner, forced recirculation pump, induced-draft fan, and all controls. Built in standard sizes from 250,000 to 2 million btu per hr. Also available in a series of larger units designated as type LFS with capacities to 10 million btu per hr. See performance data in 1953 ASME Catalog and Directory, page 191.

15 SUPER REFRACTORIES

Carborundum Co.—Form 5120, "Super Refractories By Carborundum," deals with the ability of these products to perform under a variety of chemical, temperature, load, and abrasive conditions. Included are, permeability, expansion coefficient, and reaction to heat shock. The text material is supplemented with many charts, tables, and illustrations, together with application data.

16 DRAFTING MACHINES

Universal Drafting Machine Co.—The new Universal Boardmaster drafting machine is described as having greater accuracy plus rugged construction, efficient control plus over-all convenience. Usable in horizontal, sloping, and vertical positions. Features, specifications, and accessories are listed.

17 AUTOMATIC CONTROLS

Mercoid Corp.—A complete line of automatic controls and mercury switches are illustrated and described in Mercoid catalog No. 700A. These electrically operated controls cover a wide range of applications involving the automatic control of pressure, temperature, liquid level, and for lever arm mechanical operations. Various types of mercury switches are made in numerous circuits.

18 STEEL FLOORING AND ARMORING

Dravo Corp.—Machinery Div.—Catalog No. 1103 describes various types of open-steel flooring and armoring and discusses different types of Tri-Lok open-steel flooring and safety treads. Specification data, safe-load tables, installation methods, and other pertinent information, are included.

19 TUBING

Bundy Tubing Co.—New 20-page booklet, in color, contains technical data and fabricating information on Bundy weld steel (copper or tin-coated) tubing of particular interest to production and design engineers in metalworking industries.

20 BEARING MOUNTING AND REMOVAL

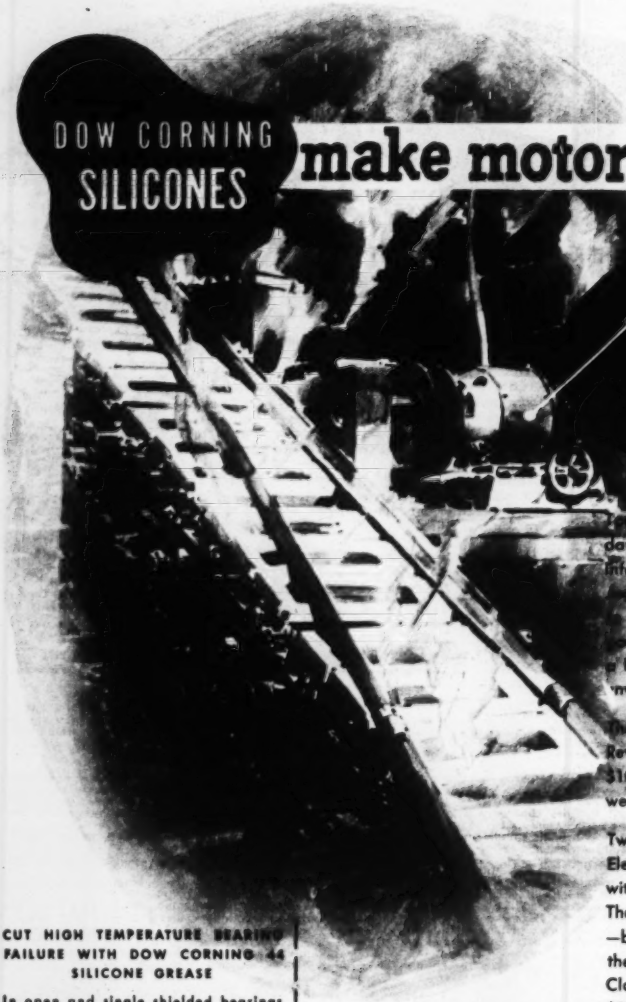
SKF Industries, Inc.—Bulletin 344 describes system of hydraulic removal, a bearing mounting and removal system pioneered by SKF. Using simple equipment, oil is forced between the roll neck and the bearing bore, pressure breaks the fit, the bearing slides off quickly and easily, safe from damage to bearing or equipment. Practical applications are given.

21 STEAM GENERATORS AND FURNACES

Petro-Chem Development Co.—Two Technical Bulletins: 50-1 and 50-2, which describe and illustrate Iso-Flow Steam Generators and Iso-Flow Furnaces. Bulletin 50-2 contains a detailed summary

DOW CORNING SILICONES

make motors last longer



Tough operating conditions are the order of the day for the 5 hp hot-ingot conveyor motor at The Infield Metals Corporation in Waterbury, Conn. Logged on a 20-second cycle, it never gets up to speed. An unending procession of freshly-poured ingots at 600° to 2100° F passes within a few feet of it. The quenching system keeps it enveloped in clouds of steam.

The motor used to fail at least every 3 weeks. Rewinding with Class A insulation cost about $109. Down time and lost production expenses were about the same.

Two years ago the motor was rewound by the Electric Motor Repair Company of Waterbury with Dow Corning Silicone (Class H) Insulation. The initial cost was higher—approximately $235—but the motor has not failed since. Based on the 3-week service life of Class A, that means Class H has paid for itself over 30 times, saved $3471 in rewind costs alone.

That kind of performance in thousands of installations has proved that Dow Corning Silicone Insulation has 10 to 100 times the life expectancy of the next best class of insulating materials; increases the power pound ratio in electrical equipment by as much as 50%.

CUT HIGH TEMPERATURE BEARING FAILURE WITH DOW CORNING 44 SILICONE GREASE

In open and single shielded bearings designed for high temperature operation, Dow Corning 44 Silicone Grease has 8 to 10 times the life expectancy of conventional greases. It gives lifetime lubrication in permanently sealed bearings.

mail this coupon Today

Dow Corning Corp., Dept. Q-23, Midland, Mich.
Please send me:
- ☐ Catalog of Class H Insulating Materials.
- ☐ List of Class H motor repair shops.
- ☐ Data on Silicone Grease for motor bearings.
- ☐ 32-page booklet entitled "What's A Silicone?"

Name_____

Company_____

Street_____

City_____ Zone_____ State_____

DOW CORNING CORPORATION
Midland, Michigan

DOW CORNING SILICONES

Atlanta • Chicago • Cleveland • Dallas • New York • Los Angeles • Washington, D.C
In Canada: Fiberglas Canada Ltd., Toronto • In England: Midland Silicones Ltd., London

of the design and operating characteristics and operating test data on a 30,000 lb per hr Iso-Flow steam generator installation. Bulletin 50-1 describes and illustrates the Petro-Chem Iso-Flow furnace, radiant convection design, and includes the significant design and operating characteristics of these cylindrical furnaces which are in extensive use throughout the petroleum, chemical, and allied industries.

22 AIR MOTORS

Bellows Co.—Bulletin CL-30 describes and illustrates the Bellows air motor—the air cylinder with built-in valve and speed control regulators. Thirty pages of case history photographs, diagrams, wiring circuits, technical data, and dimensional information. Brief descriptions of other Bellows "control-air-power" devices are included.

23 LIQUID METERS

Buffalo Meter Co.—Niagara meter catalog bulletin No. 31 describes the simplest volumetric displacement meters for almost all liquids including cold water, hot water, petroleum products, oils, syrups, solvents, and many corrosive chemicals. Stainless steel meters have proved highly satisfactory for corrosive products. Registers are totalizing for continuous use, set back for batch measurement, or electri-contact type for automatic shut-off of liquid flow.

24 SPREADER STOKERS

Hoffman Combustion Engineering Co.—Catalog No. 51-CAD describes and illustrates features of moving-grate spreader stokers. Catalog 51-PDG describes, illustrates, and supplies additional information on spreader stokers with dumping grates. Capacities from 20,000 to 250,000 lb of steam per hr.

25 SPACE HEATERS

Thermobloc Div. of Prat-Daniel Corp.—New 8-page catalog, NGC-10-52, features full-color cutaway illustration of Thermobloc heating unit with all components itemized and explained. Includes installation photos, pictures, and descriptions of all models of the Thermobloc line. Specifications and dimensions on six models ranging from 100,000 Btu per hr output up to 2,000,000 Btu per hr output are given.

26 AXIAL-FLOW FANS

Aerovent Fan Co.—11th Edition catalog describes Aerovent "Macheta" axial-flow exhaust and ventilation, 9-in. to 144-in. direct-connected, belted, extended shaft, mancooler, pulley, duct and belted-duct fans.

27 RECIRCULATION STEAM GENERATORS

Combustion Engineering-Superheater, Inc.—A new bulletin featuring the C-E Recirculation steam generator. Either oil or gas-fired, a complete steam plant with fuel, air, and water all co-ordinated automatically under push-button control. Most compact of all currently available so-called "Package" boilers the C-E recirculation steam generator is available in steam capacities ranging from 2800 to 6000 lb of steam per hr.

28 ASH AND FLY-ASH CONVEYERS

Hahn-Pitz Corp.—Six-page catalog with supplements, describes and illustrates an economical pipeline or pneumatic unit in team consumption and maintenance. Great stress is laid on the best layout in every given case. Existing conveyers can be easily improved with considerable economies in operation and maintenance.

29 GAS-FIRED STEAM BOILERS

Mears Kane Ofeldt, Inc.—Bulletin 2J illustrates and describes the Kane gas-fired automatic steam boiler which is built to an ASME specification and size from 1 to 30 hp for steam working pressure as high as 250 lb. Boilers are compact, self-contained, completely automatic, require no attendant, and minimum floor space.

30 OIL BURNERS

Cleaver-Brooks Co.—New catalog AD-102 covers complete line of Cleaver-Brooks Hev-E-Oil Burners for commercial and industrial use. Includes illustrations of various models, listings of features, illustrations of applications, listing of specifications, and illustrations of the major feature advantages. The five sizes ranging from units burning 1 to 5 gph to 6 to 60 gph are illustrated.

31 WARREN-QUIMBY SCREW AND ROTEX PUMPS

Warren Steam Pump Co.—Bulletins S204 and WQ-50 illustrate and describe these two distinctly different types of rotary pumps, both built with internal and exterior gears, horizontal or vertical mounting, and in a variety of metals. Screw-pump capacities to 3000 gpm and Rotex to 100 gpm.

for BONDACTORS, the machines that shoot tons of concrete per hour

WINSMITH SPEED REDUCERS®

...heart of the drive mechanism

Shooting concrete, castable refractories, acoustical plastics and similar pre-mixed aggregates, in quantities up to 3 cubic yards per hour, is the tough kind of work that this Bondactor machine is cut out for.

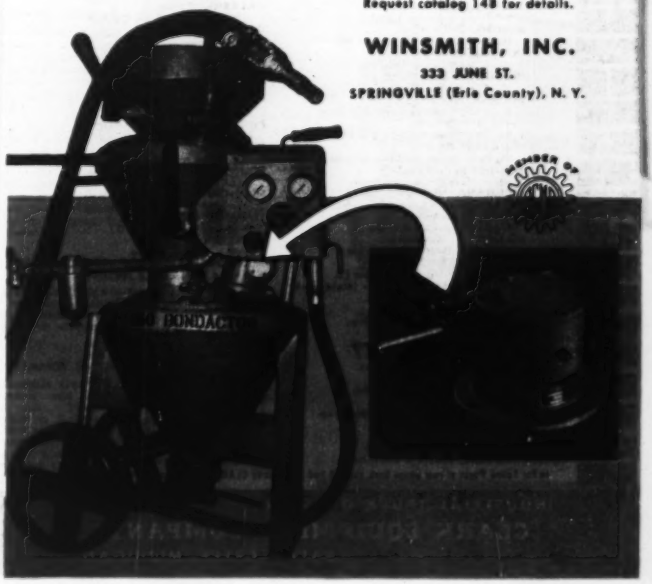
. . . and that calls for sturdiness throughout, especially the drive mechanism which bears the real brunt of running under continually heavy loads. Heart of the Bondactor's drive is a Winsmith Vertical Type, Single Reduction, Worm Gear Speed Reducer, driven by an air motor at varying speeds depending on the desired rate of feed.

Says Air Placement Equipment Co., manufacturer of Bondactor: "We started using the Winsmith Reducer about 5 years ago, and because of continual satisfaction, it has been used exclusively on all Bondactor machines."

Like Bondactor, any equipment or machines requiring speed reduction stand to gain noteworthy advantages through the selection of Winsmith Speed Reducers. Fully standardized, thereby simplifying design, installation and replacement problems, the Winsmith line is the most complete within its range of 1/100 to 85 hp and 1.1:1 to 50,000:1 reduction ratios.

Request catalog 148 for details.

WINSMITH, INC.
333 JUNE ST.
SPRINGVILLE (Erie County), N. Y.



This is the SIGN of your BEST-BUY LINE

—and it marks your BEST source of Materials Handling Service—Service that encompasses Technical Counsel, Plant Surveys, Operator Training and Engineering as well as expert Maintenance and Repairs. Look with confidence to CLARK's nation wide organization of Authorized Sales and Service Dealers.

ALABAMA: BIRMINGHAM
M-H Equipment Company
ARIZONA: PHOENIX
Braun Company
ARKANSAS: LITTLE ROCK
Bigelow Robinson Co.
BRITISH COLUMBIA: VANCOUVER
National Machinery Company, Ltd.
CALIFORNIA: FRESNO 1
Robert H. Braun Company
CALIFORNIA: LOS ANGELES 22
Robert H. Braun Company
CALIFORNIA: OAKLAND 3
Glen L. Codman Co., Inc.
COLORADO: DENVER
J. N. Meade
CONNECTICUT: NEW HAVEN 15
C. E. Reutter Corporation
DIST. OF COLUMBIA: WASHINGTON
Fallsway Spring & Equipment Co.
FLORIDA: JACKSONVILLE
Whitmore Industrial Trucks
FLORIDA: MIAMI
EquipCo, Inc.
FLORIDA: TAMPA
Whitmore Industrial Trucks
ILLINOIS: CHICAGO 4
Modern Handling Equipment, Inc.
INDIANA: EVANSVILLE 13
W. A. Marschke & Sons, Inc.
INDIANA: INDIANAPOLIS 5
W. A. Marschke & Sons, Inc.
INDIANA: SOUTH BEND 14
Materials Handling Equipment Corp.
IOWA: DAVENPORT
Big River Equipment Company, Inc.
IOWA: DES MOINES
Big River Equipment Company, Inc.
KENTUCKY: LOUISVILLE 7
W. A. Marschke & Sons, Inc.
LOUISIANA: NEW ORLEANS 7
Industrial Truck & Caster Co., Inc.
MAINE: PORTLAND
Brodie Industrial Trucks, Inc.
MANITOBA: WINNIPEG
J. H. Ryder Machinery Co., Ltd.
MARYLAND: BALTIMORE 6
Fallsway Spring & Equipment Co.
MASSACHUSETTS: BOSTON (Malden 48)
Brodie Industrial Trucks, Inc.
MICHIGAN: DETROIT 2
Material Handling Sales Corp.
MICHIGAN: GRAND RAPIDS
Material Handling Sales Corp.
MINNESOTA: MINNEAPOLIS 7
Material Handling Engineers
MISSOURI: KANSAS CITY 8
Lift Truck Sales & Service, Inc.
MISSOURI: ST. LOUIS 8
Materials Handling Equipment Corp.
NEW JERSEY: UNION
Hull Equipment Co.
NEW YORK: ALBANY
Rushmore, Weber & Case, Inc.
NEW YORK: BUFFALO 2
Brodie Industrial Trucks, Inc.
NEW YORK: NEW YORK 14
Bond Industrial Equip. Sales Co., Inc.
NEW YORK: SYRACUSE 2
Brodie Industrial Trucks, Inc.
NORTH CAROLINA: GREENSBORO
Industrial Truck Sales & Service Co.
NORTH DAKOTA: FARGO
Sweeney Brothers Tractor Co.
OHIO: CINCINNATI 15
Robert C. Young & Co.
OHIO: CLEVELAND 11
Material Handling Equipment Corp.
OHIO: COLUMBUS
Edward J. Sherry Co.
OHIO: TOLEDO 4
Kern Truck Sales, Inc.
OKLAHOMA: TULSA 6
Arst Equipment Company
ONTARIO: FT. WILLIAM
J. H. Ryder Machinery Co., Ltd.
ONTARIO: TORONTO 5
J. H. Ryder Machinery Co., Ltd.
ONTARIO: WINDSOR
J. H. Ryder Machinery Co., Ltd.
OREGON: EUGENE
Preston Faller
OREGON: PORTLAND 5
Preston Faller
PENNSYLVANIA: HARRISBURG
Furnival Machinery Co.
PENNSYLVANIA: PHILADELPHIA
Furnival Machinery Co.
PENNSYLVANIA: PITTSBURGH 33
Material Handling, Inc.
QUEBEC: MONTREAL 9
J. H. Ryder Machinery Co., Reg.
SOUTH CAROLINA: COLUMBIA
Lukas Equipment Co.
SOUTH DAKOTA: SIOUX FALLS
Stan Houston Equipment
TENNESSEE: KNOXVILLE
Dempster Bros., Inc. (I.T.D.)
TENNESSEE: MEMPHIS
Fred J. Vandemark Co.
TERRITORY OF HAWAII: HONOLULU
Pressed Steel Car Co., Inc.
TEXAS: DALLAS
T. G. Frazee
TEXAS: HOUSTON 25
T. G. Frazee
UTAH: SALT LAKE CITY
Albert J. Isaacsen Company, Inc.
VIRGINIA: NORFOLK
Wilson Industrial Equipment, Inc.
WASHINGTON: SEATTLE
Preston Faller
WASHINGTON: SPOKANE
Preston Faller
WISCONSIN: GREEN BAY
Wisconsin Industrial Truck Co., Inc.
WISCONSIN: MILWAUKEE 10
Wisconsin Industrial Truck Co., Inc.

In the Yellow Pages of your phone book, you will find your nearby CLARK dealer listed under "Trucks—Industrial"

INDUSTRIAL TRUCK DIVISION
CLARK EQUIPMENT COMPANY
BATTLE CREEK MICHIGAN

32 FLUID POWER EQUIPMENT

Oilgear Co.—8-page Bulletin 10051-B illustrates and describes complete line of fluid power pumps, motors, transmissions, cylinders, and valves. It features a new line of constant delivery pumps for pressures up to 5000 psi and variable delivery pumps, a new line of axial piston motors, an improved line of standard cylinders for pressures up to 1500 psi, and a new line of heavy-duty cylinders for pressures up to 3000 psi. It introduces standard line of pilot and directional control valves, relief and foot valves, surge (pre-fill) valves, combination valves, differential valves, and auxiliary fluid equipment for pressures up to 3000 psi.

33 MICRO PRECISION BALL BEARINGS

New Hampshire Ball Bearings, Inc.—Technical catalog lists a wide selection of instrument bearings completely processed to ABEC 5 or better tolerances. Includes retainer, flanged, spring, full, self-aligning, angular contact, and pivot types. Size range .0400 in. bore to $^{3}/_{4}$ in. OD.

34 POWER PRODUCTS DIRECTORY

Allis-Chalmers Mfg. Co.—This 40-page directory, 25B6057, lists the more than 1600 Allis-Chalmers products made for power generation, power distribution, and power utilization together with engineering literature available on a wide range of equipment for the farm, mine, industry, and utility.

35 DRAFT GAGES

Ellison Draft Gage Co.—Bulletin No. 109 describes inclined and vertical tube draft gages for field and laboratory work, for heating, ventilating, and air conditioning engineers. Constant zero. Level and tube replaceable in field. Also saturator gages for coke plants, steel mills.

36 INDUCED AND FORCED-DRAFT FANS

Green Fuel Economizer Co.—Bulletin No. 168, 20 pages, describes the Green line of induced and forced-draft fans, including stack-supporting fans. Many variations noted.

37 SOLENOID VALVES

Waterman Engineering Co.—A new illustrated booklet describes with photos and diagrams several new and improved high-pressure solenoid valves—showing their construction and their typical application. They are especially suitable for all hydraulic systems handling noncorrosive fluids.

38 BALL BEARING SWIVEL JOINTS

Chiksan Co.—Catalog No. 53-C illustrates and describes complete line of over 500 different types, styles, and sizes, with data on working pressures, maximum temperatures, dimensions, and weights. 12-page catalog No. 2A gives data on aircraft-hydraulic swivel joints for pressures from 1000 psi to 3000 psi.

39 COOLANT PUMPS

Ruthman Machinery Co.—General information, outstanding features, pipe friction chart, and cross-section prints of Gusher coolant pumps are given in a 66-page catalog. Covered are immersed-type, pipe-connected type, flange-mounted external-discharge type, and flange-mounted internal-discharge type motor-drive pumps. Shaft and pulley-driven pumps and mounting brackets and tanks are also included.

40 DUST COLLECTION

Buell Engineering Co.—"The Collection and Recovery of Industrial Dusts," a 28-page brochure 101, explains what dust is, techniques in the analysis of dust, and factors which influence choice of collection equipment. Information on cyclone, electric precipitator, low resistance, and low draft loss collectors is presented. Combination systems, special purpose collectors, and hopper valves are also discussed.

41 SELF-LOCKING PIN FASTENER

Elastic Stop Nut Corp. of America—Completely new 16-page Rollpin Catalog tells how the Rollpin is used to replace set screws and rivets, to pin or key gears, pulleys, levers, knobs; as locating dowels, stop pins, or shafts for small gear trains. Catalog is illustrated with application pictures and stories and contains exacting engineering data; recommended hole sizes, insertion and removal forces, wear resistance and strength figures. Standard diameters and lengths listed and marked as to their availability.

Use a CLASSIFIED ADVERTISEMENT
For QUICK RESULTS

42 BOILERS AND RELATED EQUIPMENT

Babcock & Wilcox Co.—Bulletin G-76 describes the B&W integral-furnace boiler type FM, a completely shop-assembled boiler for unit shipment, available in standard sizes for load ranges from 2900 to 28,000 lb of steam per hr at pressures up to 250 psi. Details of design, construction, installation and operation are discussed and illustrated.

43 FASTENERS

Townsend Co.—An 8-page catalog lists and describes various gadgets and locknuts. Typical shapes, uses, and types of both the gadgets and locknuts are given.

44 TECHNICAL BOOKS

Lefax Publishers—Over 2000 listings of Lefax pocket-size technical books are contained in the newly revised 1952 Lefax list of technical data sheets. Condensed, mathematically accurate source materials for engineers, construction men, technical workers, and technical students. Each book consists of approximately 140 pages of easily read tables and data in pocket-size, loose leaf form for handy reference right on the job.

45 DRAFTING ROOM EQUIPMENT

Hamilton Manufacturing Co.—Drafting equipment is described in Hamilton catalog No. 13-S. Auto-Shift tables with instant adjustment for height and slant from horizontal to vertical; tracing files with patented tracing lifter, making every sheet a top sheet; and a complete line of files and drawing tables to meet all requirements.

46 COLD ROLL FORMING

Yoder Co.—Equipment and process of cold roll forming, end uses of its products, advantages, and commercial possibilities. Also auxiliary equipment for curving, coiling, ring-forming, making tubular shapes, perforating, welding, embossing, and other operations which can be incorporated in a continuous high-speed cold-forming production line. 88 pages of descriptions and illustrations.

IRVING GRATINGS

★ For over 50 years Irving Gratings have played an important part in American construction and industry. Let Irving Gratings play an important part in your next job.

For Further Information Write For Booklet

IRVING SUBWAY GRATING CO., INC.
ESTABLISHED 1902

OFFICES and PLANTS at
5010 27th St., Long Island City 1, N. Y.
1810 10th St., Oakland 20, California

47 AUTOMATIC CONVEYER WEIGHING

Merrick Scale Mfg. Co.—For automatic and continuous weighing on existing or new belt conveyers, bulletin No. 375 fully illustrates and describes the Weightometer. The Merrick Feedoweight for blending and proportioning material by weight is also available.

48 AUTOMATIC DISPATCH SYSTEMS

American Monorail Co.—Bulletin AD-1 describes automatic dispatch systems consisting of a carrier, with or without hoist, plus a power-operated propulsion unit (MonoTractor), for travel on Mono-Rail track. A basic unit has been developed to accomplish the following: (1) Dispatch between two stations, (2) dispatch to multiple stations, (3) delivery to single stations, (4) delivery to multiple stations, (5) selective dispatch between multiple stations, (6) load and delivery between two stations, (7) load and delivery between multiple stations.

49 WROUGHT IRON PIPE

A. M. Byers Co.—To assist technicians in design and specification work, a 4-page bulletin contains the most frequently required data on wrought iron pipe. Consolidated tables list size and dimensional data for both standard and extra strong pipe. Complete information on threads per in., mill test pressures, circumference, external areas, length per sq ft of surface area, length per cu ft of volume, gal per lineal ft, and weight of water per lineal ft, is given.

50 GRATING, FLOORING, STAIR TREADS

Blaw-Knox Co.—Bulletin 2365 features the Electroforging—® process of manufacturing Blaw-Knox grating and stair treads. Illustrations, charts, and descriptive data point up the strength and permanence of Electroforged, one-piece construction of grating that has proved the ideal flooring for practically every industry. Two pages of this 16-page bulletin include an accurate table of safe loads, sizes, and specifications for Blaw-Knox grating and stair treads.

51 LUBRICATING SYSTEM

Trabon Engineering Corp.—Bulletin No. 8463 describes operating principles and engineering data on type "M and MX" oil and grease systems for all types of machinery. Fully hydraulic positive-piston-type valves measure lubricant in volumes from 0.010 to 0.15 cu in., use no springs or ball check valves. May be installed on new or machinery already in operation.

52 DIRECT-FIRED HEATERS

Arthur A. Olson & Co.—Illustrated bulletin presents information on gas, oil, or dual gas and oil; stoker fired; and central system heaters. Point-by-point operation, features, and sizes are given.

53 ADJUSTABLE PIPE HANGERS

Power Piping Div. of Blaw-Knox Construction Co.—New 100-page catalog 51 features the Blaw-Knox Functional spring hangers, vibration eliminators, and overhead roller assemblies. The improving and simplification of complicated piping systems is clearly explained by simple charts and specific clear line dimensional drawings. A Technical Section of the catalog enables a piping engineer to solve most hanger load problems and thus determine the hanger requirements for the particular piping under consideration.

54 CHAIN DRIVES, CONVEYERS, ROLLER CHAINS, TENSION LINKAGES

Chain Belt Co., Baldwin-Duckworth Div.—Bulletins 51-7 cover installation, operation, and maintenance of chain drives and conveyers; No. 51-2 on double pitch roller chains; and No. 51-10 on tension linkages.

55 CHANGE SPEED UNITS

Philadelphia Gear Works, Inc.—Catalog CSU-52 illustrates and describes Philadelphia change-speed units. These Herringbone gear drives are available in 2, 3, and 4-speed combinations in a complete range of sizes as speed reducers, increasers, or combination of both. Philadelphia change-speed units are widely used in wire-drawing machines and chemical mixing where exact output speeds are essential.

56 OIL BURNERS

Engineer Co.—Bulletins OB-PC and OB-37 describes wide range mechanical or steam-atomizing-type oil atomizers for all types of pulverized coal burners, also gas or oil-burning air registers, and fuel-oil pumping and heating-unit systems.

THOMAS Flexible ALL METAL COUPLINGS
FOR POWER TRANSMISSION REQUIRE NO MAINTENANCE

Patented Flexible Disc Rings of special steel transmit the power and provide for misalignment and end float.

Thomas Couplings have a wide range of speeds, horsepower and shaft sizes:
½ to 40,000 HP
1 to 30,000 RPM

Specialists on Couplings for more than 30 years

THE THOMAS PRINCIPLE GUARANTEES PERFECT BALANCE UNDER ALL CONDITIONS OF MISALIGNMENT.
NO MAINTENANCE PROBLEMS.
ALL PARTS ARE SOLIDLY BOLTED TOGETHER.

Write for the latest reprint of our Engineering Catalog.

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA

57 FLOWMETER

Hays Corp.—The new Hays Diaflow Meter is designed and engineered to measure air flow, gas flow, and the ratio of air flow to gas flow. Ideally suited for industrial furnaces, sewage disposal plants, and coast accounting. Employs pilot method of operation; dry diaphragm-type measuring element; package unit construction; complete data in bulletin 51-1017-37.

58 PNEUMATIC AIR HOIST

Detroit Hoist & Machine Co.—Bulletin 708 features a pneumatic hoist with worm drive and air-powered, rotary type motor. No pistons or reciprocating parts are employed. Air flow, continuous and pulseless, provides exceptionally smooth operation. A sensitive, self-closing control permits a hoisting speed range of "crawl" to full speed.

59 TOOL-DIE AND SPECIALTY STEELS

Jessop Steel Co.—A 60-page catalog gives applications and working data for Jessop high-speed steels, hot-work tool steels, cold-work tool steels, shock-resisting tool steels, carbon and low-alloy tool steels, and saw steels. A section on steels for special applications is also included.

60 BOILER VALVES

Everlasting Valve Co.—A new bulletin No. E125 on valves for boiler services, such as surface blow bottom blow-off, water column blow-off and connections, describes the Everlasting quick-opening and slow-opening straightway valves, angle valves "Y" valves, and duplex blow-off Units, with complete specifications, materials of construction and dimensions of each type. Illustrations include details of design, sectional and "exploded" views, and explanations of operation of the valves.

61 VIBRATORY MATERIALS HANDLING EQUIPMENT

Syntron Co.—Catalog No. 525, 52 pages, illustrates and describes complete line of equipment, including bin vibrators, vibratory feeders, weighing and batching feeders, long conveyers, shaft seals, and power tools.

62 HEAT EXCHANGERS

Sims Co.—Six-page folder gives dimensions of both stuffing-box-type heat exchanger with floating tube element and the fixed-tube plate-type heat exchanger. Numerous special heat exchangers are pictured.

63 ROLLER CHAINS AND SPROCKETS

Diamond Chain Co., Inc.—A new 112-page engineering catalog No. 649 containing complete information on roller chains and sprockets for industrial power transmission is offered. Engineering information relative to the application of roller chain drives is presented.

64 SK EQUIPMENT

Schutte & Koerting Co.—New products list folder, entitled "Index of SK Equipment and Descriptive Bulletins," lists SK products according to application and alphabetically, together with the numbered descriptive bulletin pertaining to each product.

65 STEAM AND ELECTRIC PRODUCTS

Elliott Co.—A 16-page booklet offers a quick picture of the diversity of products, both steam and electrical, which are made at Elliott's five operating divisions. These include steam and related equipment, tube cleaners, rotating electrical equipment, and large rotating electrical equipment.

66 DRAWING PENCILS

A. W. Faber-Castell Pencil Co., Inc.—Sample of any degree of Castell you desire complimentary is the best way to prove the established superiority of this superb drawing pencil. Positive accurately graded leads and greater blueprint reproductivity will be proved to you by actual tests.

67 GAGES AND THERMOMETERS

Marsh Instrument Co.—Catalog 76-I describes in detail a wide line of quality industrial gages and thermometers. The catalog is fully illustrated including cutaway photographs and enlargements of internal parts. Covered also are gage accessories, specifications, including line drawings, dimensional tables, and templates covering every size and pattern.

68 HIGH-TEMPERATURE STEELS

U. S. Steel Subsidiaries—Catalog gives a detailed discussion, supplemented with photographs, drawings, charts, and tables, covering the properties and characteristics of steels in high-temperature service.

69 BLOWERS, EXHAUSTERS, PUMPS, ETC.

Roots-Connersville Blower Div.—Regularly issued individual bulletins covering centrifugal blowers and exhausters; rotary positive blowers, gas pumps, liquid and vacuum pumps; positive displacement meters, and inert gas generators.

70 TITANIUM ALLOY

Kennametal Inc.—Folder describes Kentanium, a new heat-resistant titanium alloy that resists thermal shock, withstands oxidation, and retains great strength at high temperatures (1800 F and above).

71 CENTRAFIRE STOKERS

Westinghouse Electric Corp.—Booklet No. B-3890-A. The Westinghouse link grate combined with the centrafire principal gives controlled distribution of air and coal over entire combustion area. This unit will fire any grade coal, create optimum burning, and discharge ash without interrupting coal feed or reducing capacity. Fully illustrated and diagrammed.

72 PROTECTIVE COATINGS

Pittsburgh Coke & Chemical Co.—A new booklet on Pitt Chem Cold Applied Tar Base Coatings describes the properties of the four types of coatings manufactured by the company and gives application directions. A full-page chart lists a comprehensive selection of typical structures and corrosive agents and recommends the coatings best-suited for each application.

73 FANS AND BLOWERS

Hartzell Propeller Fan Co.—Revised general catalog No. 21A describes, illustrates, and gives specifications for the general line of Hartzell fans and blowers.

outstanding opportunity

for the right design & research engineer in the field of axial flow turbo machinery

Experience requirements . . .

- **Mechanical design and layout of axial flow turbines, compressors and fans.**
- **Familiarity with fluid dynamic flow principles as applied to design.**
- **Knowledge of experimental testing of turbo machinery.**

Apply, write or telephone Phil Carr

AiResearch Manufacturing Co.

9851 Sepulveda, Los Angeles 45, Calif. • ORegon 8-2221

Positions open in Los Angeles and Phoenix, Arizona

74 GUTTERS AND DOWNSPOUTS

Sharon Steel Corp.—12-page booklet helps take much of mystery out of use of straight chromium-type stainless steels. Includes fabricating instructions and illustrations of straight-chrome stainless gutters and downspouts in use for many years.

75 COPPER AND COPPER ALLOYS

Revere Copper and Brass, Inc.—Booklet contains complete technical data on all leading Revere alloys. It includes material on coppers, brasses, bronze alloys, nickel alloys, manufactured forms, aluminum products, welded steel tube, lockseam tube, welding techniques, and a condensed list of products.

76 FLEXIBLE SHAFT COUPLINGS

Poole Foundry & Machine Co.—Catalog 52 fully describes various types and sizes of flexible shaft couplings including medium duty, standard, mill motor, disengaging, vertical, other special types.

77 DRAWING PENCIL

Eagle Pencil Co.—Sample of new improved Turquoise drawing pencil made with 100 per cent electronic graphite is offered. Laboratory tests show it to be smoother, longer-wearing, blacker, more opaque, and capable of holding a fine needle point without crumbling. Specify degree desired.

78 STEAM SEPARATORS

Strong, Carlisle & Hammond Co.—Central power stations, chemical plants, food process plants, oil refineries, paper mills, laundries, and many other types of industry can benefit from using a reflash steam separator described in sales bulletin 54. The reflash steam separator is available in different sizes and is easily installed.

79 SELF-ALIGNING COUPLINGS

Koppers Co., Inc.—Fast's Coupling Dept.—Six-page folder on Fast's self-aligning couplings gives graphic illustrations of principles and features of these couplings; table of utility factors for various kinds of connected machines; and tables of rating for standard forged-steel couplings and heavy-duty-type couplings.

80 BOILERS AND STOKERS

James Leffel & Co.—28-page Bulletin No. 236, describes 6-hp to 250-hp (these are normal and conservative ratings and are subject to considerable overload capacities) Leffel Scotch-type boilers and underfeed stokers. Photos and cutaway drawings show design and application details. Test results, case studies, and specification data are included. The Leffel automatic underfed stoker is also suitable for other makes of Scotch-type boilers.

81 PIPE LINE STRAINER

J. A. Zurn Mfg. Co.—Engineering Data Manual No. 951 contains complete descriptive and illustrative details of pipe-line strainers for all purposes. Duplex strainers in plug, disk, and gate types; Sinlex, Y-type, and special strainers in size range from $^3/_8$ to 24 in. inclusive.

82 CONVEYERS

Mathews Conveyer Co.—Catalog 151, 68 pages of design details and illustrations cover roller and wheel conveyers. A complete line of high-quality rollers ranging in diameter from 1 in. to $6^1/_2$ in., and in capacities from 50 to 16,000 lb is shown in convenient sequence. Wheel conveyers are described and illustrated.

83 HYDRAULIC LUBRICANT PUMP

Trabon Engineering Corp.—Bulletin No. 514 gives complete data on the "Hydra-Lube" pump and reservoir assemblies for oil or grease systems. Readily adaptable to machine tools, mining machines, presses, and other equipment using hydraulic power. Adjustable volume discharge gives fully automatic lubricating system without electric or mechanical connections.

84 FLOW SIGNAL TRANSMITTER

Hagan Corp.—The Hagan flow signal transmitter is described in a new bulletin, No. 2551. This pneumatically operated pressure-differential measuring unit transmits proportional signals to remote recording or indicating instruments, or to automatic control elements. The signals may be linear with flow or linear with pressure differential. Diagrams in the bulletin illustrate seven suggested uses of the transmitter in measurement of flow, liquid fuel, liquid level, and absolute pressure. Flow applications include measurement of steam output from a boiler, superheater or evaporator; of feedwater flow to a boiler; of liquid flow through pump units; and of gas, vapor, or liquid flow in process systems.

85 ELECTRIC RADIANT PANELS

Edwin L. Wiegand Co.—New Chromalox electric radiant panels are described in illustrated 6-page bulletin, CS-605. Folder explains how this new infrared generator can be used for paint baking, curing, drying, degreasing, and other operations. Dimensions, ratings, and intensity controls are also listed.

86 TUBE FITTINGS

Parker Appliance Co.—Catalog No. 203 describes Parker industrial tube fitting in all current types, sizes, shapes, and material. This catalog also includes a section on tube fabricating equipment, information on flaring tools, tube cutters, hand tube benders, and bench-mounted tube benders.

87 CONDENSIFILTER

Hankison Corp.—Hankison model B-30 Condensifilter, which removes water and oil from compressed air used to operate instruments, is described in a new two-page bulletin. Measuring only 15 in. high × 9 in. in diam, this compact unit removes water by condensing the air through passing it over a series of cooling copper coils, then removes oil, sludge, and other foreign material by passing the compressed air through a filter cartridge consisting of five hexagonal chambers in parallel. Self-purging trap automatically discharges the condensate.

88 VISUAL TACHOMETER

Boulin Instrument Corp.—4-page, 2-color, illustrated bulletin summarizes specific uses and ad-

water
is important to everybody...

The Miss at this fountain of youth would be mighty disappointed if low water pressure were suddenly to deprive her of a drink—and so would millions of others who take water pressure for granted. One of the best, and least expensive ways to assure the constant flow of water is through Centrilining.

The Centriline process thoroughly cleans and centrifugally applies cement-mortar to the interior of pipe lines in place—prevents corrosion, tuberculation and leakage; minimizes interruption of line operation and street traffic. For an effective, economical means of increasing flow capacity, look to Centriline.

Write for free booklet today.

CEMENT-MORTAR LININGS FOR PIPES IN PLACE

2,500,000 FEET OF EXPERIENCE

CENTRILINE CORPORATION

A subsidiary of Raymond Concrete Pile Co.

140 CEDAR STREET, NEW YORK 6, N. Y.

Branch Offices in Principal Cities of United States and Latin America

ON THE WEST COAST, WRITE PIPE LININGS, INC., P. O. BOX 3428, TERMINAL ANNEX, LOS ANGELES, CALIFORNIA

4000 "ANSWER" MEN

To Help You With

TODAY'S POWER PROBLEMS — TOMORROW'S POWER PLANS

FOR YOUR BENEFIT, 4000 technical experts, representing over 300 leading manufacturers, will be on hand to discuss your current problems . . . future plans . . . explain how you can adapt the improvements you see, to your operations . . . how you can reduce costs, improve products, raise plant efficiency, expand or modernize your facilities.

YOU'LL SEE informative, interesting, displays and demonstrations of the latest developments in products, materials and methods for the most efficient power production, distribution, and use, materials handling, and plant services.

BE SURE TO ATTEND . . .

9278

20TH NATIONAL POWER SHOW

National Exposition of
Power & Mechanical Engineering

GRAND CENTRAL PALACE, New York

DEC. 1-6

ASME Auspices in conjunction with Annual Meeting

MANAGEMENT: INTERNATIONAL EXPOSITION CO.

vantages of measuring rotary and vibratory speeds from a distance and without contact, by means of visual hand tachometers. Cites numerous instances of use under widely different conditions in air conditioning, aircraft, automotive, chemical, oil, and textile industries.

89 VALVES

Golden Anderson Valve Specialty Co.—A new 8-page bulletin G-3 describes the features of cushioned automatic water and steam valves. Featured are float valves, altitude valves, check valves, solenoid-operated valves, reducing valves, relief valves, and non-return valves.

90 HEAT EXCHANGERS, EVAPORATORS, FEEDWATER HEATERS

American Locomotive Co., Alco Products Div.—Catalog No. AL-3, 16-page general catalog, describes Alco's products and manufacturing facilities, including data and illustrations on conventional, multipurpose, and air-cooled heat exchangers; evaporators, feedwater heaters, pressure vessels, prefabricated piping, and welded steel pipe. Construction and application of patented flex-tube evaporators are described and illustrated, together with selection data on heat exchangers.

91 FLEXIBLE SHAFT POWER DRIVES

Elliott Mfg. Co.—Catalog No. 221, describes applications of flexible shafts for power drives and heavy-duty power drives. It gives factors which determine specifications and primary requirements in engineering flexible shaft power drives. It lists information required by Elliott engineering service in offering solutions to power transmission problems, without cost or obligation.

92 FAFNIR FLANGETTE

Fafnir Bearing Co.—6-page Folder describes a complete power transmission unit, incorporating a Fafnir wide inner ring ball bearing, and self-locking collar. Housings are interchangeable steel flanges with inside surfaces matching bearing outer ring, thus providing initial self-alignment in all directions. Folder carries photos, installation instructions, sizes, and load ratings.

Read the various items listed . . . one catalog may hold the solution to your present problem . . . select those items of interest to you. *Distribution by us to students is not included.* The coupon on page 44 should be mailed promptly. It must reach us on or before December 15th as none will be filled after that date.

93 MILITARY COMPUTERS AND GUNFIRE CONTROLS

Ford Instrument Co.—New, illustrated, two-color folder describes the background and lists the major facilities of the company that pioneered gunfire controls and is now a major division of The Sperry Corp. Products listed in so far as military security rules permit.

94 REVOLVING UNIT HEATERS

L. J. Wing Mfg. Co.—Bulletin HR-6 is the latest revised edition of a 16-page bulletin, illustrated with many new photographs of installations. Describes and illustrates ceiling-suspended, downward discharge unit heaters with revolving discharge outlets that distribute the heated air in slowly moving streams. Air flow reaches into far corners, around machinery and obstructions, avoiding hot blasts and cold spots, and giving sensation of fresh, live, invigorating warmth to workers. Engineering data and installation details.

95 GRATING—FLOORING, SAFETY TREADS

Irving Subway Grating Co.—Catalog No. F-225 contains illustrations, descriptions, and engineering data on fireproof, durable, safe, clean, and economical gratings and safety steps (riveted, pressure-locked, and welded) for industrial plants, power plants, refineries, ships, railroad freight and passenger cars, and locomotives, open steel-mesh bridge decking, etc.

96 VANE-TYPE HYDRAULIC PUMP

Denison Engineering Co.—New series of vane-type pumps, built for continuous duty at 2000 psi and convertible to fluid motor applications without alterations of any kind, are shown in bulletin P-5. The series includes models and sizes offering pump deliveries up to 70 gpm, and motor-torque capacities up to 257 in-lb per 100 psi.

97 MOTOR SPEED CONTROLS

General Radio Co.—New folder describes complete line of Variac ® motor speed controls with power-handling capacities from $^1/_{10}$ to $^3/_4$ hp. Complete speed-torque curves, schematic diagrams, and various applications are depicted in considerable detail. Dimensions, prices, and ordering information are included.

98 MINIATURE BALL BEARINGS

Miniature Precision Bearings, Inc.—New 4-page catalog, illustrated with comprehensive specifications on more than 120 types and sizes of standard miniature ball bearings from $1^1/_2$ mm to $^3/_8$ in. OD. Includes material of particular interest to designers of precision mechanisms—applications, lubrication, design variations, special bearings, etc.

99 PULVERIZERS AND CRUSHERS

Jeffrey Mfg. Co.—Materials being successfully reduced by Jeffrey swing hammer pulverizers and crushers, cross-section views of various sizes, capacity tables, and many photos of these and other types of reduction units are given in a 36-page catalog No. 837.

100 DUST AND FLY ASH COLLECTORS

Fly Ash Arrestor Corp.—Pamphlets SC-11 and SC-12 describe high-efficiency and high-capacity multiple cyclone dust and fly-ash collectors, give technical descriptions of collectors, along with illustrations of installations and typical arrangement data.

101 ENGINEERED FILTRATION

Cuno Engineering Corp.—New, 6-page bulletin No. 1148-PJL, gives complete data on Cuno Auto-Klean filters—edge filtration plus positive mechanical cleaning; Cuno Flo-Klean filters—backwash filter cleaning with no loss of fluid; Cuno Micro-Klean filters—replaceable element micronic filters. Description of models and capacities for industrial filtration installations.

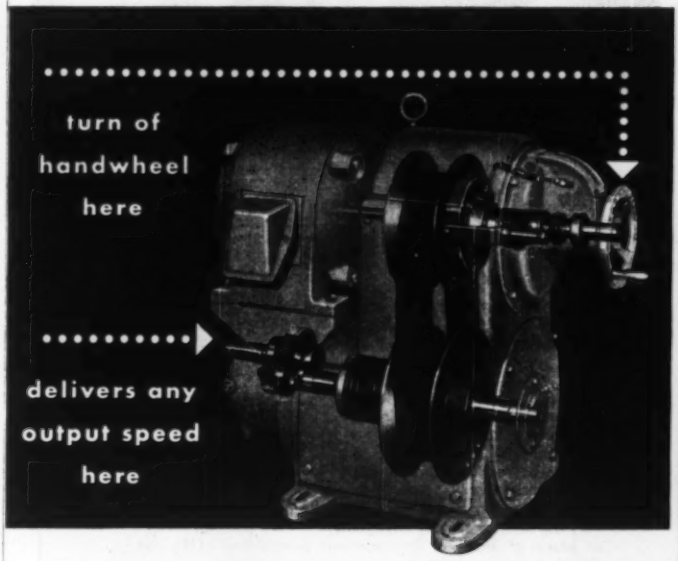
102 DIRECT, POSITIVE COPIES

Charles Bruning Co.—A new, illustrated brochure—"The Copyflex Process"—describes in detail this modern, low-cost method of copying as used by business and industry everywhere. Booklet includes information on the operation of Bruning Copyflex (Whiteprint) equipment and the various uses of the unsurpassed range of Copyflex sensitized materials.

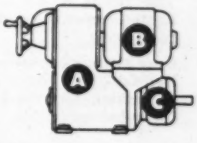
103 SMALL PURIFIERS

V. D. Anderson Co.—New 6-page bulletin, No. 500, describes the small line type Hi-eF Purifier. Folder lists many functions of this new unit which is used to clean up small pipe lines carrying live or exhaust steam, vapors, and air.

Simplify your speed-changing methods with Reeves Vari-Speed Motodrive®



A complete, variable speed power plant in one, compact package that releases the *full* profit potential of every machine . . . every operator



REEVES Vari-Speed Motodrive incorporates (A) REEVES speed-changing mechanism, (B) any standard, constant-speed motor, and (C) gear reducer in a single, space-saving unit easily applied to any machine. Turn of handwheel or touch of button delivers any desired speed—instantly, accurately, *positively*—without stopping the machine. Widens machine work range; increases rate and quality of production; and utilizes highest skill of operator. Specify REEVES Vari-Speed Motodrives for the machines you build or buy. Sizes to 25 hp; speed ratios as great as 10 to 1. Send for free catalog to Dept. 14ME.

REEVES PULLEY COMPANY • COLUMBUS, INDIANA

Recognized leader in the specialized field of variable speed control

REEVES Variable Speed Drives

for accurate speed control

WITH

HELI-COIL* INSERTS

These stainless steel wire inserts strengthen threads so greatly that stripping is eliminated, thereby allowing you to utilize the full tensile strength of each cap screw. You can: (A) *use smaller cap screws* – (B) *use fewer cap screws* – (C) *use shorter thread engagement* – (D) *use cap screws in place of studs or bolt-and-nut assemblies* – (E) *use lighter bosses and flanges.*

Inexpensive ***Heli-Coil*** wire inserts, easily wound into slightly oversize tapped holes, remain permanently in place, providing easy-running female threads that are immune to wear, galling and corrosion.

The result is an improved product – cleaner looking, lighter, easier to service—frequently at reduced manufacturing cost.

Case histories, pointing up these benefits, are presented in ***Heli-Coil***, our engineering periodical which is yours for the asking. Use the handy coupon to put your name on the subscription list.

*Reg. U. S. Pat. Off.

HELI-COIL CORPORATION

331 SHELTER ROCK LANE, DANBURY, CONN.

☐ Please send catalog, giving full engineering specifications

☐ Please send *Heli-Coil*, a free case-history periodical

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____ 1704

104 ELECTRIC PAN-L-HEAT OVENS

Advance Heating Div., Jensen Specialties, Inc.—16-page bulletin, illustrated, on electric heating ovens, driers, and booster heaters for finishes, varnishes, coatings, textiles, paper, glazes, adhesives, cements, foundry molds and cores, preheating castings, expanding metal parts, and many other applications. Describes electrical construction, mechanical and thermal features and capacities. Also informational form to secure specific recommendations.

105 SILICONE PRODUCTS

Dow Corning Corp.—A Reference Guide to Dow Corning Silicone Products is a revised general catalog which lists over 50 different Dow Corning silicones according to their physical form and applications. Important properties of each product and code numbers for obtaining more information about any particular product are conveniently presented in this 4-page bulletin.

106 FLEXIBLE SHAFTING

F. W. Stewart Mfg. Corp.—Bulletin "Flexible Shaft Assemblies," describes new power drive circle Ess flexible shafting. Greater opportunity for diversified streamlined power transmission is offered for use in all types of metal, plastics, porcelain, or woodwork. They can be applied in hundreds of finished operations. Three types of power drive flexible shafts are presented—for heavy, medium, and light duty in commercial or industrial work.

107 LIQUID METERS

Neptune Meter Co.—New 20-page bulletin describes meters for handling over 100 industrial liquids in processing, batch mixing, cost control operations. Includes Auto-Stop meter with automatic quantity control for accurate formulas. New meter-selector charts give complete selection and specification data for over 30 different liquid meters. Capacities from 2 to 1000 gpm, temperatures to 250 F, pressures to 500 psi.

108 ADJUSTABLE SPEED DRIVES

Reliance Electric and Engineering Co.—Bulletin D-2311 covers features of the Reliance adjustable speed drive. Components included are (1) the convenient operator's control station, (2) the adjustable speed motor, (3) the control unit.

109 CONVEYER ROLL BEARINGS

Marlin-Rockwell Corp.—M-R-C conveyer roll bearing bulletin (Form 1529) is a 4-page $8^1/_2 \times 11$-in. illustrated folder on M-R-C CONV-3-SF and CONV-4-SF ball bearings. These bearings are specially designed for use on conveyer rolls, and have four important features, resulting in reduced machining operations, cheaper mounting costs, reduced belting cost, and improved belt alignment.

110 DUST AND FUME COLLECTORS

Northern Blower Co.—Catalog 1002-6 describes exhaust fans for dust collecting and air handling and includes complete performance tables, test curves, etc. Plans and elevations of typical dust-collecting installations are shown. Separate additional bulletins contain descriptions, dimensions, capacities, etc. of Norblo bag type, hydraulic type, and centrifugal dust collectors.

111 METALWORKING PUNCHES AND DIES

T. H. Lewthwaite Machine Co.—Notebook size catalog sheets listing in an easy-to-locate arrangement the wide range of metal working punches and dies carried in stock for immediate shipment. Styles to fit most makes of hand, foot, and power-operated punch presses are standard. Hand-operated punches, cutters, and benders are also illustrated and described.

112 IRON CEMENTS

Smooth-On Manufacturing Co.—40 page, pocket size Smooth-On Repair Handbook describes practical, time-saving, money-saving repairs made on plant, shop, factory, garage, and home equipment with Smooth-On iron cements. Leaks stopped, cracks sealed, loose parts, and fixtures tightened. More than a million copies of this popular Manual have already been sent out in response to requests. Contains 170 diagrams. Clear tested directions.

GIVE

and give generously

113 VERTICAL CENTRIFUGAL PUMPS

Lawrence Pump & Engine Co.—"Vortex"—not just a sump pump. Whenever your industrial pumping problem concerns a vertical unit, either dry pit or wet well installation, consult "Vortex" engineers for your best answer. Write for bulletin on "Vortex" Vertical Pumps.

114 CUTTING FLUIDS

D. A. Stuart Oil Co.—A reliable guide to better machining through proper selection and application of cutting fluids is offered. Contains handy chart which aids in selecting cutting fluids for various metal-working operations. Two articles—"Mechanisms of Metal Cutting" and "Chemistry of Cutting Fluids" will help the shop man to better understand cutting-fluid functions and enable him to obtain more efficient operation.

115 ELECTRIC MOTORS

Jack & Heintz.—Folder describes custom-built electric motors for variety of uses. Motors can be specially engineered for applications requiring odd voltage or frequency, polyphase, direct current, quick reversing, special mounting, special shaft specifications, and custom painting.

116 AXIAL-FLOW BLOWERS

Blower-Stoker Div.—Read Standard Corp.—Publication No. 88 gives dimensional, capacity, and other engineering data on Standardaire low, medium, and high capacity blowers. Includes isometric drawing showing location of all blower accessories, also suggested applications and typical users.

117 CHUCKS, AIR AND WRENCH OPERATED

Cushman Chuck Co.—Catalog PO-64-1952, listing air operated chucks, air cylinders and controls; gives prices and engineering data on chucks and cylinders designed to operate without clatter at high speeds to provide low cost, timesaving tooling. Catalog 64-1952 listing wrench operated chucks; gives prices and engineering data on chucks recommended for engine, toolroom, manufacturing turret and automatic lathes.

118 ELECTRICAL MACHINERY

Fairbanks, Morse & Co.—Bulletin E100H, "Catechism of Electrical Machinery," presents the most important theoretical and practical features of common types of direct-current and alternating-current motors, generators, and control equipment. Intended for those who are not familiar with electrical phenomena or terminology. The text is illustrated with Fairbanks-Morse machinery, and in some cases the details of these machines are discussed.

119 OIL-HARDENING STEEL

Firth Sterling Steel & Carbide Corp.—Catalog 20-080 describes Chimo, a tough, oil-hardening steel originally developed for tools that resist shock, vibratory stresses, and hold a good cutting edge. Provides complete information about typical analysis, characteristics, heat-treating, etc.

120 VALVES

Ohio Injector Co.—A new catalog 51-FS shows a complete line of 600-lb forged steel, gates, globes, angles, checks, and screwed flanged socket-weld type in standard and special trim.

121 ALUMINUM FORGINGS

Aluminum Co. of America.—A 171-page book, "Designing for Alcoa Forgings," outlines forging processes and shows how they affect various problems and principles of design. Recommended forging design proportions are given in tables and illustrated by specific examples.

122 SOOT BLOWERS

Copes-Vulcan Div.—Continental Foundry & Machine Co.—New bulletin No. 1001 offers in condensed form, pertinent data on modern automatic-sequential soot blowing systems, including control panels and descriptions of air or electrically operated rotary long and short retractable units and manually operated units. Many construction details are shown and a complete list of representatives for U.S.A. and Canada is included.

123 ELECTRONIC ANALOG COMPUTATION

George A. Philbrick Researches.—Catalog and manual on GAP/R high-speed all-electronic analog computation describes line of components from which computors for many purposes may quickly be assembled; shows applications to study and design of dynamic structures and such control systems as industrial regulators and servomechanisms; presents philosophy and mathematical techniques for most effective usage.

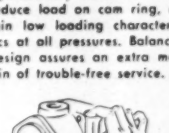
More Stamina
FOR YOUR HYDRAULIC CIRCUITS

DENISON HydrOILics

PUMP/MOTOR

Pump/Motors are made in four sizes, each offering a series of inter-changeable cam rings, providing capacities to meet your specific need.

Complete Radial Balance
Hydraulically balanced vanes reduce load on cam ring, retain low loading characteristics at all pressures. Balanced design assures an extra margin of trouble-free service.



Rugged Space-Saving Design
Compact construction makes Denison Pump/Motors easier to adapt to any circuit plan. Model TMB12, shown above, delivering up to 7.5 gpm at 2000 psi, is only 4⅛" high, 4⅛" wide, and 8" long including the shaft.

Denison's dual-purpose Pump/-Motors combine rugged, compact design with *hydraulic balance*—they *stand up longer* under continuous, heavy-duty use at 2000 psi.

Hydraulically balanced vane and rotor action means smooth, uniform, radially balanced operation. It assures minimum wear on both the vanes and the cam ring, and reduces surge and pulsation to a minimum. For added efficiency, vanes are designed to contact the cam ring with *dual sealing edges.*

Operating at 1200 rpm and 2000 psi, the four Pump/Motor sizes offer pumping capacities from 2.7 to 70 gpm, and motor torque ratings range from 13 to 257 pound-inches per 100 psi. And all models are *ready to operate* as either pumps or motors, without alterations of any kind.

Wherever you need rugged power for circuits developing up to 2000 psi, Denison Pump/-Motors offer *the finest money can buy.* Write for Bulletin P-5.

The DENISON Engineering Co.
1189 Dublin Rd., Columbus 16, Ohio

No more worries about...
FREQUENCY RESPONSE or WRITING SPEED with the

HATHAWAY Type SC-16 OSCILLOGRAPH

The NEW and PHENOMENAL Hathaway Type SC-16 Oscillograph with 6 elements is *flat from 0 to 200,000 cycles per second, and its traces have a writing speed of 5 million inches per second.*

Fast transients and high-frequency phenomena can be accurately recorded.

Several types of continuous-drive record magazines are available for 6-inch sensitized paper and film, and for 35-mm film. Drum-type magazines, both small and large, are valuable for short high-speed records. 10-foot drum-type charts can be driven at 3000 RPM for a chart speed of 6000 inches per second when high resolution is needed.

Useful for strain recording to 100 Kilocycles.

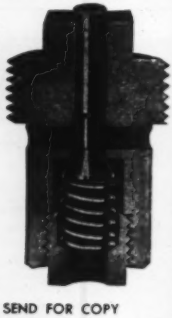
Automatic Operation Initiate a transient with the oscillograph, or let the transient start the oscillograph.
Quick-Change Transmission for wide range of record speeds.
Precision Time Lines. Z-Axis Modulation for timing to 1/10 millisecond.
Quickly-Interchangeable Lens Stages for different record and trace widths.

Write for Bulletin 2GI-N and free copy of Hathaway Engineering News

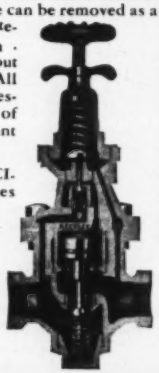
Hathaway INSTRUMENT COMPANY
1315 SO. CLARKSON STREET • DENVER 10, COLORADO

UNIT PILOT VALVE

MAKES KECKLEY REGULATORS EASIER TO SERVICE AND MAINTAIN



Here is a unique Keckley feature that means extra convenience and savings for you. The pilot valve can be removed as a unit. This means easy inspection, maintenance or replacement in a few minutes time. No bother with separate parts—comes out as easily as the spark plug in your car. All other parts of this valve are readily accessible too! All wearing parts are made of tough, long wearing, corrosion resistant stainless steel, further lowering upkeep.



Check into the Keckley line of PRECISION PRESSURE REGULATORS. Sizes ½" to 6"—pressure to 300 lbs. steam, 600 lbs. air reduced to a low of 1 lb. Various combinations for pressure and temperature control. Ask our representative, your industrial distributor or write.

SEND FOR COPY OF COMPLETE CATALOG 51D.

- Float Valves
- Pressure Regulators
- Temperature Regulators
- Float Boxes
- Pop Safety Valves
- Strainers
- Level Controllers
- Diaphragm Valves

O. C. KECKLEY COMPANY
400 W. MADISON STREET CHICAGO 6 ILLINOIS

124 HEAT-TREATING FURNACES

Westinghouse Electric Corp.—A complete line of heat-treating furnaces—gas-fired or electric—and protective atmosphere generators are described in forty-page book No. B-5459 with useful calculating tables, definitions, and temperature conversion table.

125 NYLON LINED BEARING

Thomson Industries, Inc.—Trade name NYLINED Bearings. Four-page illustrated brochure outlining the basic advantages of nylon as a bearing material and showing how its use in the NYLINED construction principle enables a bearing for less friction, longer life, dry operation, corrosive conditions, and silent operation. Literature also describes how the NYLINED principle overcomes many of the limitations of plain, molded, or machined nylon bearings.

126 NICKEL ALLOYS

International Nickel Co., Inc.—Standard Alloys for Special Problems is an illustrated 16-page booklet that describes in detail the mechanical and other properties of nickel, Monel, and other Inco nickel alloys. It lists the mill forms in which these materials are produced as well as applications for which they are especially suited.

127 HYDRAULIC TURBINES

James Leffel & Co.—Two new bulletins tell about recent Leffel hydraulic installations. Bulletin No. 1085 describes the Leffel installation at the Bureau of Reclamation's new Anderson Ranch Dam, with photos, statistics, etc. Bulletin No. 1086 contains information on a Leffel turbine used in the expansion of TVA's Wilbur Dam, with photos, field-test results, cross-section of installation, etc.

128 TONNAGE OXYGEN PRODUCTION

Blaw-Knox Construction Co., Chemical Plants Div.—Catalog 2402, 24 pages, describes the Linde-Fraenkl process for the production of low-cost tonnage oxygen. Advantages, cost of operation, features, and industrial uses of gases produced by the process are included.

129 WORM GEAR SPEED REDUCER

Cleveland Worm and Gear Co.—Catalog 400 (1952 edition) illustrates and describes all models in the Cleveland Worm Gear Speed Reducer line. Its 180 pages present engineering data on each type, including dimensions, weights, and horsepower capacities—all the information needed to arrive at proper selections of drives for any kind of power-driven equipment.

130 PNEUMATIC INDUSTRIAL CYLINDERS

Westinghouse Air Brake Co.—A new streamlined class of pneumatic industrial cylinders—both with noncushioned and cushioned adjustable stroke—are described in leaflet No. 9438-I. Solid barrel construction with rotating heads provides compactness and ease of installation. They are available in diameters from 1½ in. up with stroke and mounting to suit any requirement.

131 SOOT BLOWERS

Diamond Power Specialty Co.—Catalog No. 1014 describes the complete line of Diamond soot blowers for both air and steam cleaning and having manual, air or electric operation. Completely automatic sequential systems are described and their advantages discussed. This catalog also contains some interesting background material indicating that soot is a better insulator than asbestos.

132 FLAT LAPPING

Crane Packing Co.—16-page booklet, fully describing the new "Lapmaster" method of flat lapping to extremely close tolerances on an automatic, high production basis. Photographs, diagrammatic drawings, and complete data on "John Crane" Lapmaster Models "12", "24", "36", "48", and "72" provide profitable information for all industries whose manufacturing operations include finishing parts to precision surface flatness and finish.

133 VIBRATION CONTROL

MB Mfg. Co.—Products for the detection, reproduction, and isolation of vibration are described in bulletin 410. Booklet contains helpful design data on vibration control, plus information on Isomode pad, Isomode units, and details on MB vibration exciters and test equipment.

134 HYDRAULIC OIL POWER EQUIPMENT

Vickers Inc.—Catalogs 1-5001 and M-5101 contain general design information and specifications of a complete line of pumps, valves, controls, and re-

lated equipment for oil hydraulic power transmission in machine tool (general industrial field) and mobile equipment industries, respectively. Individual units, also standardized or custom-built power units, transmissions, and control panels available.

135 FASTENINGS

H. M. Harper Co.—New Price List and Stock Book covers complete line of nonferrous and stainless-steel fastenings. Containing 56 pages, the book is printed in color with every type of fastening shown in natural color. An index page lists all fastenings by alloy and type for fast easy reference. Included in the booklet are complete descriptions of all Harper Everlasting Fastenings carried in stock in brass, bronze, copper, Monel, aluminum, and stainless steel.

136 ELECTRIC MOTORS

Westinghouse Electric Corp.—Booklet B-4731 describes the new Life-Line motors which are available up to 700 hp for all industry. Especially designed to eliminate excessive working costs and to give top electrical performance, these Life-Line motors are constructed in steel for greater protection against shock and strain. Dust, dirt, and dampness, the enemies of electrical apparatus, are crippled by the exclusive mechanical and electrical devices included. Drip-proof, splashproof, vertical motors are features in this booklet.

137 CAST STEELS

Lunkenheimer Co.—A 52-page brochure discussing Lunkenheimer cast steels describes their manufacture, properties, and applications in a simple and nontechnical manner. Also included is a discussion of today's basic problems; the manufacture and test of valves; the properties of the various classes of cast steels; ASME code rules, and a glossary of engineering terms in connection with cast-steel valves.

138 HELICAL GEAR SPEED REDUCERS

Foote Bros. Gear & Machine Corp.—Manual LPB illustrates, describes, and contains complete application data on Line-O-Power straight-line helical gear speed reducers. This new line features Duti-Rated high hardness precision helical gears assembled into rugged cast housings of streamlined design. These drives are available in double or triple reductions with ratios up to 238 to 1 for capacities up to 178 hp.

139 THERMOSTATS

Fenwal, Inc.—Catalog on unique Thermoswitch* heat control, a precision thermostat having outstanding advantages of instant response, high accuracy, wide range, rugged construction and ease of installation. Catalog describes wide application and gives full engineering details, and shows how Thermoswitch unit can often replace expensive control instruments. (*Reg. U. S. Pat. Off.)

140 TUBE-SUPPORTED WALLS

Bigelow-Liptak Corp.—12-page 2-color catalog on tube-supported walls for industrial boilers describes in detail how Bigelow-Liptak walls may be suspended directly from boiler tubes with resulting savings in steel and erection time. Engineering drawings show typical jobs and describe how the enclosure is fastened to the boiler tubes.

Read the various items listed . . . one catalog may hold the solution to your present problem . . . select those items of interest to you by number . . . fill in coupon on page 44 and mail promptly.

Engineered . . .

to permit greater load-speed capacity

Amerigear
*Trade Mark Reg.
COUPLING
The Proven Gear-Type Coupling With Fully Crowned Teeth . . . A Major Improvement In Gearing
Pat. & Pat. Pending

THIS FUNDAMENTAL IMPROVEMENT in gear tooth design practically eliminates all "end tooth and tip" contact and provides greater freedom of axial movement. This tooth design accomplishes tight fit on the crown as well as on the flanks. It is the first gear tooth on which all the load is carried on strong flanks rather than tooth edges. It reduces backlash to a minimum. These advantages, plus thrust compensation, and correction for angular and lateral misalignments give maximum relief from coupling failure grief.

Amerigear Couplings, made in several standard types, are available for standard shaft sizes and a wide range of speed and load capacities. Catalog of standard type Amerigear Couplings is available on request. Amerigear Power Transmission Engineers are available for consultation.

AMERICAN FLEXIBLE COUPLING COMPANY

Originator of the Amerigear Fully Crowned Tooth

Sales Offices in Principal Industrial Centers

ERIE, PA., U. S. A.

AFFILIATE OF J. A. ZURN MFG. CO.

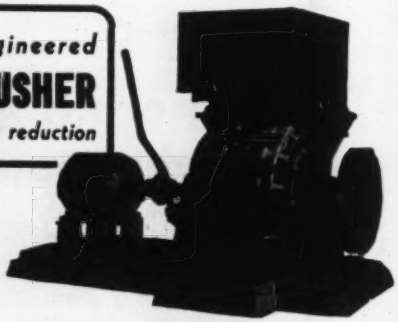
Write on your Business Letterhead for further information regarding *Amerigear Couplings* with the *Fully Crowned Teeth* and Catalog 501.

Also Manufacturers of
The Original "Oldham Type" American Flexible Coupling

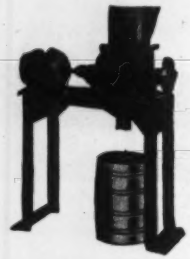
There's a job-engineered

AMERICAN CRUSHER

for uniform . . . low-cost reduction



. . . of COAL, CLAYS, CHEMICALS, STONE, METAL TURNINGS, WOOD, DRY ICE, FOOD—hundreds of products of every description.



Metal Turnings Crusher—reduces long, curly turnings of steel, alloys, brass, aluminum, etc., to uniform chips for highest cutting oil recovery . . . increased scrap value.

Laboratory Mill—for testing, pilot plant operation and waste reduction.

"AC" Ring Mill—with exclusive shredder rings—for uniform, high tonnage reduction. 500 TPH. "24 Series" ring or hammer crushers offer capacities to 50 TPH. . . . "30 Series" Hammermills to 100 TPH.

Write for complete information on the famous American line of crushers.

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1541 MACKLIND AVE.
ST. LOUIS 10, MO.

Nicholson Expansion Steam Traps

SAVE $155 PER UNIT

for Large Processor

Because of their positive effectiveness in temperature control work, Nicholson expansion steam traps, at about $35 each, are being installed by a leading processor in place of temperature controls. These were costing them $110 to $200, with cost of trap added. Per installation, the saving is about $155.

This firm is finding an increasing number of applications on tanks, stills, heating radiators, etc., where Nicholson expansion steam traps are serving as both trap and temperature controller.

Because there is only one moving part, remarkably low maintenance costs are being shown. Easily installed, usually without supports. Lengths, 9" to 40". Pressure, 0 to 250 lbs. No air binding.

For All Equipment Using Steam or Hot Water

Radiators
Separators
Paper Machinery
Pipe Coils
Kettles
Railway Coaches
Dry Kilns
Vulcanizers
Switch Heaters
Laundries
Plastic Molding Presses

CATALOG 751 or see Sweet's

219 Oregon St., Wilkes-Barre, Pa.

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

141 CONVEYER SYSTEMS

Allen-Sherman-Hoff Co.—Pneumatic ash and dust handling systems catalog No. 652 outlines general principles of pneumatic design and describes the proper application of components. Illustrations are shown of various hopper types, a clinker grinder, and a complete pneumatic system using a steam ejector to produce vacuum.

142 THRUSTORQ FORCE-MEASURING DEVICE

Hagan Corp.—The Hagan "ThrusTorq," air-operated force-measuring device is pictured and described in bulletin No. 9345. The ThrusTorq is employed in engine-testing laboratories, engine and aircraft factories, automotive and petroleum industry laboratories and plants, and in chemical and other plants for continuous and intermittent weighing applications.

143 STAINLESS-STEEL SHEET AND STRIP

Washington Steel Corp.—A new bulletin describes MicroRold stainless-steel sheet and strip, produced by the Sendzimir process of continuous cold reduction. Physical properties, specifications, standard type numbers, and analysis of MicroRold stainless are included. Featured by type number is a discussion of the application and uses of each type of MicroRold.

144 ELECTRIC MOTORS

Delco Motors Div.—An 8-page bulletin illustrating Delco fractional horsepower motors, Delco single-phase general-purpose motors, Delco single-phase definite-purpose motors, Delco industrial motors, and Delco polyphase industrial motors. Featured is a cutaway showing exclusive Delco features.

145 VALVES

Lunkenheimer Co.—"Lunkenheimer Guide" is an illustrated, thumb-indexed catalog of representative Lunkenheimer valves—iron, steel, and bronze—in all pressure classes. Also gives complete information on Lunkenheimer boiler mountings and lubricating devices. Includes information for selecting and specifying hundreds of popular Lunkenheimer valves.

146 BITUMASTIC PROTECTIVE COATINGS

Koppers Co., Inc.—Informative package of six bulletins covers (1) Bitumastic Hi Heat gray for high-temperature corrosion prevention; (2) Bitumastic Black Solution for general, low-cost maintenance; (3) Bitumastic Super-Service Black, heavy-duty coating for more severe conditions; (4) Bitumastic No. 50, extra heavy-duty coating for extremely severe corrosive conditions; (5) Bitumastic No. 28, heavy-duty coating for atmospheric corrosion control; (6) Bitumastic Tank Solution, quick drying, useful for water tanks, air-conditioning equipment, etc.

147 ELECTRIC MEASURING INSTRUMENTS

Westinghouse Electric Corp.—Booklet B-4696 covers the most complete line of electrical measuring instruments in the industry—portable, panel, switchboard, socket, and recording—for measuring all electrical quantities. This fully illustrated booklet also tells how to select, apply, and order Westinghouse instruments.

148 FLOWMETERS

Hagan Corp.—Ring balance mechanical flowmeters are described and illustrated in detail with photographs, diagrams, and data on dimensions and capacities in bulletin 2M50. Covered is the ring balance principle of operation, which is said to be unique in that it maintains high accuracy at low flows. Among other reported features are ease of adjustment, recalibration by deadweight method or by a water column, high accuracy and elimination of over-range-operation troubles, for both low-pressure and high-pressure flowmeters of this line.

149 WATER VAPOR PHYSICS

Pittsburgh Lectrodryer Corp.—Bulletin No. 218, "The Moisture in Our Atmosphere," a 12-page bulletin, discusses the fundamental physics of water vapor. The nature and behavior of water vapor are treated in a logical down-to-earth manner with psychrometric chart explanations. The use of solid adsorption equipment for dehumidification is also described.

150 INDUCTION HEATING

Ohio Crankshaft Co., Tocco Div.—New catalog J2, 20 pages, describes the principles, applications, and equipment of Tocco induction heating. Typical results of induction hardening and heat-treating, and results of induction heating for forming and forging are given.

151 HEAT-TRANSFER EQUIPMENT

Griscom-Russell Co.—A pictorial bulletin illustrates and concisely describes many types of heaters, coolers, condensers, and exchangers for various industries.

152 GEARING AND GEAR DRIVES

Western Gear Works—Bulletin 5201 describes the latest developments in gearing and gear drives for the aircraft industry. The booklet shows an extensive variety of mechanical power transmission units of all types for both ground and air-borne application, with technical explanation.

153 PIPE AND TUBES

National Tube Co., Tubing Specialties Div.—Bulletin 26 presents technical data on 25 alloy steels suitable for high-pressure high-temperature service. Includes many tubular products manufactured in accordance with ASME Boiler Code specifications. Relative cost figures aid in selecting best alloy for special service.

154 STEEL AND ALLOY PLATE FABRICATION

Nooter Corp.—Catalog lists the many specialized techniques and services of Nooter in the fabrication of tanks and vessels for the petroleum and chemical processing industries. Corrosion data charts provide valuable information on resistance values of commonly used metals with reference to hundreds of chemicals.

155 SOLENOID PILOT VALVES

Valvair Corp.—A new 8-page illustrated bulletin "P" describes a new Valvair solenoid pilot valve for controlling air, vacuum, oil, and water. Mechanical drawings show 2-way, 3-way, and 4-way, single and double models, with exhaust port plugged for manifold mounting and for other applications. Complete parts are listed for all models, together with parts numbers and designations on drawings.

156 MIXED BED DEMINERALIZER

Permutit Co.—4-page booklet No. 3591 describes system consisting of a single ion exchange unit containing a homogeneous mixture of cation and anion exchangers. Advantages and applications are outlined.

157 PUMPS

American-Marsh Pumps, Inc.—Boiler Feed and General Service Pump Bulletin No. 381 describes and pictures this ball bearing, horizontally-split case, two-stage, single-suction centrifugal pumping unit. Shows electric motor and steam-turbine-driven models. 12 important features in large cross-section, specifications, general dimensions, meta-specifications, and modifications.

158 ROLLER CHAIN

Link-Belt Co.—148-page illustrated book No. 2457 discusses precision steel roller chain and its application. Detailed engineering information covers selection, installation, lubrication, and maintenance of roller chain and sprocket wheels for drives and conveyers.

159 WEIGHING MACHINES

Toledo Scale Co.—This 42-page catalog gives full information on all types of Toledo scales for industrial weighing, testing, counting, balancing, classifying, and force measuring. Fully illustrated, including installation photos showing the scales in actual use. Special emphasis is given printed weights that eliminate human errors.

160 MOTORIZED GEAR SPEED REDUCERS

D. O. James Gear Mfg. Co.—Catalog 46-B, 48 pages of engineering data and prices of D.O. James motorized worm gear speed reducers. Horizontal or vertical drive, ration range of 6:1 to 100:1, 1/4 to 30 hp. Horizontal drive slow speed shaft either right or left hand assembly. Vertical drive slow speed shaft extends upward or downward.

161 OIL FILTERS, STRAINERS, OILING DEVICES

Wm. W. Nugent & Co., Inc.—Seven bulletins: No. 6 illustrates and describes Nugent pressure strainers; No. 7, gravity filters; No. 7A, pressure filters; No. 8, tanks, pumps, shaft oilers; No. 14, oiling and filtering systems for turbines, paper mills, steel mills, pumps, compressors; No. 15, oiling devices; No. 16, sight feed valves, multiple oilers, flow indicators, sight overflows, and compression union fittings.

162 WATER TREATMENT

Permutit Co.—Permutit Data Book No. 2478A is a 116-page 5 × 7 1/4 in. book for all engineers and municipal officials who have water treatment as

These
EXAMPLES OF VERSATILITY

Two of four Steel Shell Condensers with Ampco 8 Heads and Tube Sheets. These condensers were built for export to the Middle East.

One of 4 Fermentors, 12'0" x 22'7" high tangent. 10% Stainless Clad, type 304 Stainless . . . manhole body and connections type 304 Stainless. Each fermentor equipped with coils of 3" O.D. x 14 ft. tubing . . . type 304 Stainless.

This condenser is 16" DIA. x 12' tube length; Bundle ¾" O.D. type 316 Stainless tubes; Double tube sheet also of type 316 . . . manufactured by the Heat Transfer Division of DOWNINGTOWN.

One of two all-Aluminum units fabricated by DOWNINGTOWN IRON WORKS, INC. (Welding was performed by the Inert-Gas-Metal-Arc method.)

One of six carloads of Heat Exchangers, Coolers, Condensers and Reboilers designed and fabricated by our Heat Transfer Division. Materials used consist mainly of Type 304 Stainless Steel.

show that DOWNINGTOWN can help YOU, too

CORRECT DESIGN
RIGHT MATERIALS

. . . yes, DOWNINGTOWN's experience and research in the fabrication of various grades of Carbon Steel, Stainless Steels, Nickel-Clad, Stainless-Clad, Monel-Clad, Cupro-Nickel, Aluminum, etc., may be of help to you. We are equipped with the most modern facilities to handle complete jobs, within our limitations, in the correct alloys and methods of fabrication required to assure maximum operating efficiency.

DOWNINGTOWN also maintains a Heat Transfer Division under the direction and supervision of men thoroughly trained and experienced in this field. Our engineering Consultation is at your service to aid you in preparation of plans and specifications for definite jobs.

Useful literature sent upon request on your business letterhead. Remember: "Your Needs are Our Specialty."

DOWNINGTOWN IRON WORKS, INC.
DOWNINGTOWN, PA.
STEEL & ALLOY PLATE FABRICATION
HEAT EXCHANGERS

NEW YORK OFFICE, 30 CHURCH STREET

KENNEDY

Fig. 544P

JOB-FITTED

for longer disc and seat life... where accurate control is a must

Like all valves in the complete KENNEDY line these bronze globe valves are JOB-FITTED . . . specially designed and engineered for the job they have to do!

UNION BONNET RING, heavy bronze section with extra thread engagement to assure a tight joint. Union bonnet makes a valve easy to dismantle and reassemble.

STEM, Naval Brass Rod, Acme threads, large diameter with extra thread contact . . . extremely resistant to wear.

PACKING, molded rings of graphited, wire-inserted asbestos designed for high pressure service.

PLUG TYPE DISC, nickel copper alloy, has extra wide seating surfaces for precise throttling control . . . is exceptionally resistant to scouring or wire drawing.

RENEWABLE SEAT RING, nickel copper alloy, ground to match disc in each valve to assure full bearing surfaces over entire contact area of each.

KENNEDY Fig. 544P, plug type disc, and Fig. 544, full-way disc, are designed for 300 lbs. steam, 600 lbs. WOG. Fig. 138P, plug type, and Fig. 138, full-way disc, for 200 lbs. steam, 400 lbs. WOG.

WRITE FOR BULLETIN 108

Est. 1877

THE **KENNEDY**
VALVE MFG. CO. • ELMIRA, N.Y.

VALVES • PIPE FITTINGS • FIRE HYDRANTS

their responsibility. It discusses hydraulics of water impurities, coagulants needed, explains the various treatment processes, and gives other data pertinent to the field.

163 CELLULAR RUBBER

Sponge Rubber Products Co.—New title, "Properties of, and Test Data on Cellular Rubber" explains 20-page content of technical work on open cellular structure rubber; hard and soft closed cellular structure rubber; and silicone compounds of each. Companion piece describes application made of various types.

164 PIPING DESIGN

Power Piping Div. of Blaw-Knox Construction Co.—The design of piping for flexibility with Flex-Anal Charts is covered in an 86-page book. It fills the need for the flexibility analysis of any piping system. It is intended for the experienced pipe designer who can, by use of this method and the application of Flex-Anal Charts, accurately analyze most piping systems in a few hours which formerly required days and even weeks. Many tables, Flex-Anal Charts, and typical piping layouts are included.

165 ADJUSTABLE FLOW REGULATORS

Waterman Engineering Co.—An adjustable flow regulator for cylinder speed control is described. This adjustable regulator gives a constant rate of flow regardless of pressure fluctuations or change in work resistance at any setting within the adjustable range. Adjustable range is 50 per cent of the calibrated flow rate in gpm. It is available for hydraulic systems with operating pressures to 3000 psi. Line sizes are $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, and $\frac{3}{4}$ in. NPT (dry seal). Maximum controlled flow is 16 gpm.

166 ION EXCHANGERS

Permutit Co.—Dual bed ion exchanger booklet No. 3667 gives simple inexpensive method for removal of hardness and alkalinity. Eliminates need for elaborate regeneration equipment and for handling acids and lime as unit employs resins regenerated with plain salt. Advantages and applications of this system outlined.

167 EXPANSION JOINTS

American District Steam Co., Inc.—The new ADSCO Corruflex Bulletin contains complete information on packless expansion joints. Many pages are devoted to simplified selection and installation data and to the design and construction of the packless joint. The bulletin includes discussions of thrust, forces, traverses, anchors, alignments, and related topics.

168 REMOTE CONTROLS

American Chain & Cable Co., Inc.—Bulletin No. DH-287 describes applications of various types of push-pull remote controls for installations ranging from delicate instruments to heavy earth-moving equipment. There is a question and answer section pertaining to construction, efficiency, backlash, deflection, temperature ranges, and weather resistance.

169 FACTORY-ASSEMBLED BOILER

Erie City Iron Works—Bulletin SB43 describes the VL-2-drum water-tube self-contained furnace-boiler. These factory assembled boiler-furnace units are available through 300 hp for oil, gas, underfeed, or spreader-stoker firing. Larger sizes for field erection. 20-page catalog gives concise engineering data and includes large user list.

170 PIPING FABRICATION AND ERECTION

Dravo Corp.—A 24-page illustrated booklet, bulletin No. 1700, shows piping installations in steel mills, for gas transmission systems, central power stations, water pumping stations, heating plants, oil refineries, and chemical process plants. Dravo's engineering and fabrication facilities are also illustrated and described.

171 EFFECTS OF CHECK VALVES IN OVERCOMING WATER HAMMER

Williams Gauge Co.—The cause, effect, and control of water hammer in piping systems are considered in a new 8-page bulletin. After describing water hammer in nontechnical terms, the brochure indicates its potential damage to piping, instruments, and other parts of water systems, and then considers methods of controlling it.

172 WATER TUBE BOILERS

Henry Vogt Machine Co.—A 16-page bulletin describes Class VF and Class VS 2-drum bent-tube boilers. Photos and line drawings with design data illustrate typical units as installed in various industries.

173 HIGH-SPEED STEEL

Firth Sterling Steel & Carbide Corp.—Catalog 10-070 describes Van Chip M-3, a new molybdenum-tungsten high-speed steel that is especially useful where abrasion resistance and ability to hold close tolerances is important. Gives complete data, such as, typical analysis, characteristics, heat-treating, applications, etc.

174 METALWORKING MACHINES

O'Neil-Irwin Mfg. Co.—New 32-page catalog describes how Di-Acro precision metalworking machines perform a wide variety of forming, cutting, and punching operations in medium and lightweight materials. Seven basic Di-Acro machines—benders, brakes, notchers, punch presses, rod parters, rollers, and shears are available in 36 hand and power-operated models. Machine specifications and material capacities are arranged in tabular form for quick easy reference.

175 WATER PROBLEMS

Hall Laboratories, Inc.—Industrial water problems of all kinds—procurement, treatment, usage, and disposal—and the facilities and services offered in coping with them are described and charted in a new booklet. It points up the importance of water in all kinds of industries and industrial operations.

176 DUST CONTROL

W. W. Sly Mfg. Co.—A revised 20-page treatise, bulletin No. 98, on industrial dust collection discusses the principles of dust control by filtration, determination of air volume, hood design, piping, and other features, and contains numerous diagrams, tables, and other valuable information.

177 ROLLER CHAIN, SPROCKETS

Morse Chain Co.—Catalog C55-50 gives details on prices, available sizes of over 400 sprockets, and information on stock roller chain from ¼ to 2-in. pitch. Also included are data on dimensions, drive selection, service factors, installation, and maintenance.

178 BEARING BRONZE

Bearium Metals Corp.—4-page stock list shows weights of over 750 sizes cored and solid bearing bronze bars up to 10 in. OD. Includes information on highly superior frictional properties found in Bearium Metal—a bronze devised primarily for bearings, bushings, and thrust washers.

179 EXPANSION JOINTS

Badger Mfg. Co.—Catalog features directed-flexing self-equalizing and nonequalizing expansion joints: D-F S-E joints, in various metals and alloys, for wide ranges of pressures and temperatures. Nonequalizing for low pressures—thermal expansion table, installation diagrams, and data on flanged ends, welded ends, traverse, axial movement, etc. Designed to meet custom requirements.

180 SUMP PUMPS

Deming Co.—Bulletin No. 4600A lists features, typical installations, accessories, etc., of vertical sump pumps.

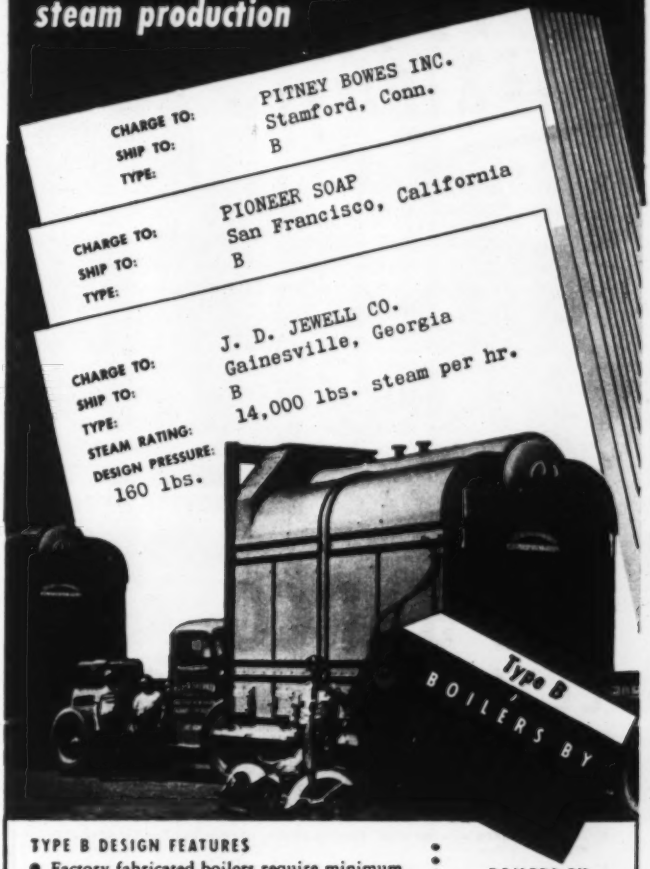
181 ELECTRIC MOTORS

Reliance Electric and Engineering Co.—Bulletin B-2101 gives construction features, selection data, prices, how to order, and dimensions of Reliance precision-built electric motors.

ENGINEERING MANPOWER COMMISSION OF ENGINEERS JOINT COUNCIL
AND
ENGINEERS COUNCIL FOR PROFESSIONAL DEVELOPMENT
COOPERATING TO:

FOR INFORMATION WRITE TO:
ENGINEERING MANPOWER COMMISSION
29 W. 39th ST., NY 18, NY

JUST WHAT THE ENGINEER ORDERED
For compact, efficient steam production



TYPE B DESIGN FEATURES

- Factory fabricated boilers require minimum field work.
- In many cases, sizes up to 330 HP can be shipped completely assembled.
- Water tubes along furnace side walls reduce maintenance costs.
- Furnace design provides high efficiency with any method of firing.
- Extremely low head room. Maximum capacity for floor area.
- Can be operated at high overloads without disturbing water level.

Write for free catalog on the Type B or on any of the units listed below.

BOILERS BY BIGELOW

Water Tube Boilers — Bent Tube Types
Horizontal Return Tubular Boilers
Scotch Type Boilers
Two-Pass Boilers
Electric Steam Generators

BI-11

THE BIGELOW COMPANY • NEW HAVEN 3, CONN.

BIGELOW REPRESENTATIVES: Boston • New York • Chicago • Philadelphia • Syracuse • Detroit • Atlanta • Milwaukee • New Orleans • Oklahoma City • Petersburg, Va. • Washington, D. C. • San Francisco • Los Angeles • Seattle • Knoxville

Use BARCO FLEXIBLE BALL JOINTS

THE SOLUTION FOR MANY PROBLEMS! The BARCO Flexible Ball Joint is one of the most useful, most versatile fittings ever developed for application on piping conveying steam, oil, gas, water, air, chemicals, refrigerants, or other fluids. Find out how these simple, rugged, economical joints can help you:

- **Overcome piping misalignment! Provide simple, trouble-free flexible couplings for steam or air lines.**
- **Provide for movement in piping — up to 40° side flexibility in any direction, plus 360° swivel action. Widely used in loading and unloading lines.**
- **Protect piping against strain, stress, settling, shock, or vibration! Excellent for outside service piping connections to buildings, large storage tanks.**

COMPLETE LINE—15 different sizes, ¼" to 12". Angle or straight, male or female threaded connections—flanged connections—welding ends for welded connections. Available in materials suitable for temperatures from −50° to as high as 1,000° F.; for pressures from vacuum to 750 p.s.i. steam, or 7,500 p.s.i. hydraulic. Fire-proof, pressure-safe! Standard throughout the world—available through leading supply companies.

ENGINEERING RECOMMENDATIONS—Barco factory and field engineers are ready to help you solve your problems. ASK FOR NEW CATALOG NO. 215 "BARCO FLEXIBLE BALL JOINTS."

BARCO MANUFACTURING CO.
1821 M WINNEMAC AVE. CHICAGO 40, ILL.
The Only Truly Complete Line of Flexible, Swivel, and Revolving Joints
FREE ENTERPRISE—THE CORNERSTONE OF AMERICAN PROSPERITY

182 INSTRUMENT TEST STANDS

U. S. Electrical Motors Inc.—Variable-speed test stands for testing hydraulic pumps in industrial laboratories, also magnetos, generators, alternators, constant-speed drives, and actuators are described in new Aero Test-Stand bulletin 1749. The unit powers components at simulated speeds and is widely used not only in aircraft plants but in governmental laboratories and test departments of industrial instrument firms.

183 COOLING TOWER EQUIPMENT

J. F. Pritchard & Co.—Complete line of specialized equipment is covered by latest illustrated catalog No. 1.19.092B. In addition to describing medium and large mechanical draft cooling towers, atmospheric types, and small packaged models, catalog provides information on cooling-tower nozzles, fans, fan drives, air and gas-treating equipment, and air-cooled heat exchangers.

184 OSCILLATING CONVEYERS

Link-Belt Co.—24-page book No. 2444 contains layout drawings, selection charts, dimensions, and weights for "PA" positive action eccentric-type oscillating feeders and conveyers, both torsion mount for heavy-duty and new Flexmount for lighter-duty applications. Particularly recommended for sharp, abrasive, fine, lumpy, sticky, or hot materials.

185 DROP FORGINGS

Drop Forging Association—"Metal Quality—Hot Working Improves the Properties of Metal," a 64-page booklet recently revised and issued by the Technical Committee, Drop Forging Association, for design engineers, metallurgists, and production-management executives, explains how hot-working improves metal quality. The text describes forging-quality steel and details of the various methods of forging. Check lists of the advantages obtained by use of forgings, economic benefits, are included.

186 WORM GEAR MOTORS

U. S. Electrical Motors Inc.—Profusely illustrated 8-page bulletin features Type GW syncrogear motor in sizes from ¼ to 3 hp for speeds of 20 to 155 rpm and gear ratios up to 58:1. The new motor embodies a built-in worm gear and right-angle take-off shaft. A principal feature is its cantilever design for protecting gear alignment. Mounting stresses are absorbed by a pyramidal base. The gear and motor housing is free from distortion.

187 INDUSTRIAL ADHESIVES

Armstrong Cork Co.—"Armstrong's Adhesives for Industry," a 32-page manual describing the variety of adhesives for various applications as formulated by the Armstrong Cork Co. The booklet is also designed to help those who may not be intimately familiar with the subject to buy and use industrial adhesives to the best advantage, and to stimulate new ideas for the profitable use of adhesives.

188 WEIGHING MACHINES

Merrick Scale Mfg. Co.—Bulletin 851, describes automatic equipment for use in weighing materials in transit, carried on belt conveyers, and allied equipment to weigh and feed bulk materials by weight and predetermined rates. Applications of more complex weighing setups are shown.

189 VALVES

Hays Mfg. Co.—Bulletin No. 117 discusses the Hays "Electroflo" valve for appliances and industrial equipment. The Electroflo valve is used for the control of water, oil, steam, and air. Cutaway drawings illustrate the several models. Three selections of piping methods are illustrated.

190 CONSTANT DELIVERY PUMPS

Oilgear Co.—4-page bulletin No. 46601 illustrates and describes three new constant delivery axial piston pumps for pressures up to 3000 and 5000 psi. These units incorporate balanced flat valves (port plates), simple one-piece rolling pistons, and reverse-flow high-pressure and supercharging pressure relief valves.

191 BALL BEARINGS

New Departure, Div., of General Motors—Supplementing its standard catalog, a series of five books, helpful to the engineer and designer in applying ball bearings to any new machine. The first book deals with principal bearing types and fundamentals of mounting practice; the second, details of shaft and housing designs; and the third, enclosure and lubrication for varying operating conditions; the fourth book gives a new simplified method of computing bearing loads; while the fifth entitled, "Application Procedure," outlines the necessary steps in obtaining assured bearing performance. Ask for Series BS.

1952 Welding Qualifications

Now Available

Published in a new size—8½" × 11", this revised ***Section IX of the ASME Boiler And Pressure Vessel Code*** makes available the latest approved rules applying to the qualification of welding procedures and welder performance for all types of manual and machine arc and gas welding processes permitted in other sections of the code; other manual and machine welding processes, where applicable; and testing welders for performance qualification.

To facilitate utilization of the Code repetitive or similar procedure qualifications have been eliminated; the Free Bend Test has been replaced by the Guided Bend Test; operator qualifications have been grouped under a new section entitled, "Performance Qualification"; terms relating to welding have been added; forms for recording details of tests have been revised; new illustrations have been added and some of the existing ones redrawn and rearranged.

Price $1.00 20% discount to ASME members on one copy

Quantity discounts to members and nonmembers:

In lots of: 10 to 49, 20% off list price
50 to 99, 25%
100, 30%

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 West 39 Street, New York 18, N. Y.

192 LIQUEFIED GASES

Arthur D. Little, Inc.—New catalog summarizes work with the production, handling, and storage of liquefied gases. It also includes a description of a high field strength electromagnet and a review of prototype development service. The Mechanical Division of Arthur D. Little, Inc. provides science and industry with a means of developing unique prototype equipment, particularly in the areas of thermodynamics, heat transfer, refrigeration to −456 F, vacuum engineering, gas liquefaction, electromagnetism, mechanical design, and vibration.

193 PLASTIC GEARS

Westinghouse Electric Corp.—MICARTA phenolic laminate gear material for silent gear operation. 30-times greater tooth deflection than steel. Sixteen-page book No. B4661 complete with design tables and formulas along with application and machining information.

194 BOILERS

Murray Iron Works Co.—Bulletin B-114 covers the Murray Type WTE Single Drum Boiler. A completely shop assembled unit, the tube headers run along the bottom of each side of the boiler, rest directly on the foundation, and the single drum is supported on the tube banks. Thus any external suspension is eliminated. The combustion space is enclosed on all four sides by water walls, and the boiler is completely insulated and enclosed in a steel casing making it a completely shop-assembled unit.

195 AIRCRAFT CONTROL BEARINGS

Shafer Bearing Corp.—Fully illustrated catalog devoted exclusively to the Shafer line of aircraft roller bearings which are available in a full-size range of standard (specials to order) self-contained, single-row, double-row, and rod-end types for all conventional control applications for all types of air-borne craft. Contains complete specifications, engineering and application data and relative merits of the basic Shafer ConCaVex design which employs concave rollers and convex races.

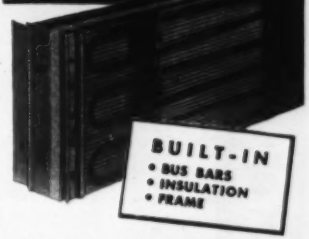
Make use of this **FREE** LITERATURE SERVICE

Select desired Catalogs by number, fill in coupon on page 44 and mail promptly.

NOW CHROMALOX GIVES YOU INTENSE FAR-INFRARED

IN PACKAGED MODULAR PANELS

READY to ERECT and CONNECT



Chromalox Electric Radiant Panels generate uniformly absorbed far-infrared heat for baking, drying, curing and other uses. Temperatures up to 700° F. are easily selected and accurately held with "dialed" controls.

THESE ADVANTAGES—AND MORE!

- **Longer Wave Length**—absorbed equally fast by all colors.
- **Shatter-proof Construction**—nothing to break or contaminate work.
- **High Intensity Radiation**—more watts per square foot.
- **Infinitely Variable Output**—from 0% to 100% of capacity.

OVEN BUILDING SIMPLE AS A-B-C

1' x 4' and 2' x 4' pre-engineered panels quickly assemble into ovens of any size.

Get This Bulletin

—It shows you how Chromalox Radiant Panels can save you time, money, work.

Industrial Radiant Heating Division 18-27A
EDWIN L. WIEGAND COMPANY
7646 Thomas Blvd., Pittsburgh 8, Pa.
I am interested in Chromalox Radiant Heat for_____

☐ Send me Bulletin CS-605 on Radiant Panels.
☐ Have your Chromalox representative contact me.
☐ Send me Catalog 50 which shows other Chromalox Units.

Name_____ Title_____
Company_____
Street_____
City_____ Zone____ State_____

CHROMALOX
ELECTRIC HEAT FOR MODERN INDUSTRY

NEW Sier-Bath Internal Gear & Bearing SCREW PUMP

For Pumping Lubricating Fluids and Semi-Fluids

Capacities 1-700 GPM; Discharge 1000 PSI for viscous liquids, 500 PSI for light oils. Horizontal or vertical construction.

New features cut maintenance requirements, provide easier servicing, longer life. Other advantages include: no metallic contact between rotors—high volumetric efficiency—only suction pressure on stuffing boxes—direct-connection up to 1800 RPM.

Sier-Bath External Gear & Bearing Screw Pumps for non-lubricating materials. Sier-Bath "Gearax" Pumps for lower pressures and capacities. REPRESENTATIVES IN PRINCIPAL CITIES.

Describes Complete Line of NEW SCREW PUMPS!

Write for "Screw Pump Reply Sheet". Shows uses, capacities, advantages—invites sales talk be filled out for prompt quotation.

Sier-Bath GEAR and PUMP CO., Inc.

9256 Hudson Boulevard, North Bergen, N. J.

Also Manufacturers of "Gearax" Pumps, Precision Gears and Flexible Gear Couplings

ROLLER BEARINGS at point of high radial load
LOCKNUTS BEHIND TIMING GEARS facilitate repairs
INTERCHANGEABLE ROTOR SCREWS make major overhauls simple, inexpensive—greatly reduce need (and expense) of periodic pump replacement
BALL BEARINGS position rotors axially for less wear on bearings and timing gears

196 METAL CHIP CONVEYERS

National Conveyers Co., Inc.—New bulletin containing illustrations, drawings, and descriptive data of National ChipVeyor systems tells how metal turnings are crushed, conveyed, and stored and how valuable cutting oil is reclaimed for reuse.

197 STEAM TRAPS

Clark Mfg. Co.—Information is available on a new development in steam trap construction, called Duo-Step Leverage. By using an ingenious double-fulcrum point and venting mechanism it is now possible to increase the drainage capacity of a trap so that it may handle twice the condensate formerly possible.

198 WELDING USES

Lincoln Electric Co.—A series of bulletins reviewing basic engineering data relevant to the design of machinery in steel. Tells how to use steel for maximum efficiency and how to weld for lowest cost manufacturing; makes possible savings up to 50 per cent of the cost of an unmachined product, reduction of 30 per cent in weight, and ability to provide greater rigidity.

199 MATERIALS HANDLING

Fairfield Engineering Co.—Catalog 151, a technical 250-page catalog contains complete specifications, illustrations, and engineering data covering the many hundreds of products manufactured by Fairfield for various industry conveying, storing, and feeding applications in handling materials. The equipment cataloged includes bucket elevators, skip hoists, belt flight and screw conveyers, feeders, crushers, portable conveyers, tile storage silos.

200 TRACING PENCIL TEST KIT

American Lead Pencil Co.—Kit contains samples of Venus tracing pencils for testing on various types of papers. This new pencil contains an active chemical to produce clearer, sharper, white or blueprints when reproduction is made from a pencil drawing.

201 CENTRIFUGAL COMPRESSORS

Carrier Corp.—32-page book entitled, "Centrifugal Compressors for Industry," covers the application and advantages of centrifugal compressors in petroleum and chemical processes requiring compression of gases or refrigeration. Fully illustrated with diagrams, charts, and photos of installations, it also contains engineering data and simple selection methods.

202 CEMENT-LINED PIPE

Centriline Corp.—Booklet describes proved method of relining pipe with cement-mortar lining, in place, that (1) permanently increases and maintains carrying capacity; (2) stops and prevents leaks; and (3) prevents discoloration of water from corrosion. Typical installations and results are described.

203 SOLENOID VALVES

Ruggles-Klingemann Mfg. Co.—Additional pages for catalog E on electrically operated valves now being printed showing new designs and typical applications. This catalog contains complete information for valves from $^1/_4$ to 12 in.

204 BLUEPRINT MARKING PENCIL TEST KIT

American Lead Pencil Co.—Kit contains samples of new Venus unique colored pencils for marking on blue or white prints. 54 per cent stronger—sharpens to a sharp needle point and holds it. 27 per cent greater markability—brilliant clear marking—waterproof.

205 THERMOSTATIC BIMETAL

W. M. Chace Co.—New 32-page booklet entitled, "Successful Applications of Chace Thermostatic Bimetal," gives compact summary on thermostatic bimetal, contains 18 uses of bimetal as the actuating element in temperature responsive devices, and condensed engineering data for bimetal element design and selection. Illustrated with various types of thermostatic devices.

206 BIN LEVEL INDICATOR

Bin-Dicator Co.—New 1952 catalog fully describes and illustrates bin level indicator which gives automatic control of machinery in response to fluctuating level of materials in silos, bins, hoppers, conveyers, etc. Dimensional drawings, mounting details, typical applications, wiring diagrams, and list of present users. Illustrated applications to stoker operation, flour packing, chemical proportioning, concrete mixing plant, packaging ores, salt, feed, chemicals, candy, etc.

207 CONVECTOR RADIATION

Warren Webster & Co.—A 12-page bulletin, B-1503, gives description, dimensions, and complete rating data on Webster type "E" convectors. Code rated for both steam and hot water. Illustrates recommended piping connections.

208 STEAM TRAP BOOK

Armstrong Machine Works—Catalog J, a completely new 44-page combination catalog and steam-trap manual, gives details of trap operation, construction, selection, installation, and maintenance. Contains charts, tables, and safety-factor data for trap selection.

209 ELECTRIC MOTORS

Westinghouse Electric Corp.—Half a century of mill-motor design and experience was put to work in the the development of the all new 600 Series mill motor, graphically described in booklet B-5791. Before designing this new motor, Westinghouse canvassed the users to find out what the industries wanted in a new design. Results? The new Series 600 mill motor incorporates ruggedness, compactness, dependability, simplicity, and less maintenance. These exclusive features are described in detail.

210 LINEAR BALL BEARING

Thomson Industries, Inc.—Trade name "Ball Bushings." 12-page illustrated catalog gives complete description of ball bearings available for linear motion and how they can be used to obtain low friction and wear, lasting precision alignment, eliminate binding and chatter, zero shake or play, long life, low maintenance, to solve sliding lubrication problems. Catalog also contains engineering information on suitable shafts, seals, dust boots, lubrication, installation data, and mounting arrangements, along with charts and tables for calculating load capacity and bearing life.

211 LABORATORY CRUSHERS

American Pulverizer Co.—Bulletin describes American Laboratory Crushers used for test sampling of pilot model operations. Describes wide variety of products which can be reduced by this crusher. Gives complete specification and design and construction data.

212 INDUSTRIAL INSTRUMENTS

Leeds & Northrup Co.—Low-cost Electromax signalling temperature controllers for two-position, position-adjusting, or duration-adjusting type control are fully described in new Catalog ND47(1). Also described is the Electromax signalling conductivity controller. Complete control systems for these electronic instruments are also fully illustrated and listed for each type of control.

213 WATER TUBE HEATING AND POWER OILERS

International Boiler Works Co.—Catalog and specification sheet describing water tube steel heating and power boilers, includes pictures and cuts showing effective baffling arrangements which provide economical performance with all fuels and any method of firing. Made in standard sizes from 10 to 600 bhp. See our performance data in 1953 ASME Mechanical Catalog and Directory, page 191.

214 TURBINE PUMP MOTORS

U. S. Electrical Motors Inc.—New 16-page bulletin presents the improved line of U. S. Verticlosed motors for powering deep well turbine pumps for production of water for industrial municipal and irrigation use. Bulletin shows full-color views of the motor and interior construction including hollow shaft design, Visolube and Lubriflush lubrication systems, automatic backstops, and a score of other exclusive features. Also includes description of solid shaft U. S. vertical motors.

215 O-RINGS

Linear, Inc.—Compact 6-page folder contains tables of standard O-ring sizes as well as dimensional data for installation. Notes give general recommendations on clearances, design, material, machining, and finishes for most O-ring applications. A special compound bulletin containing descriptions of the latest polymers and synthetic rubbers from which O-rings can be molded is also included.

For Consulting Engineers Turn to Page 166

GUARD AGAINST EXPLOSION with R-C INERT GAS GENERATORS

Portable R-C Inert Gas Generator used for purging operations and stand-by protection in large gas-producing plant. Capacity 15,000 cfh.

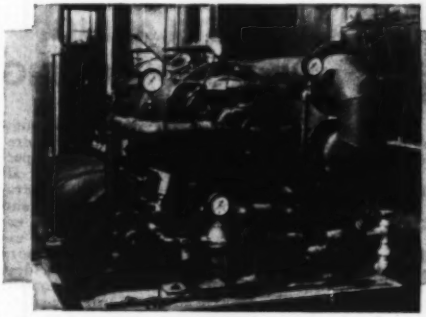
If your operations involve materials or processes which might cause an explosion-produced fire, you can reduce the risk with R-C Inert Gas Generators. In many instances, the relatively small cost is absorbed by savings in insurance costs.

These mobile or stationary units instantly produce a continuing flow of inert gas, for use in purging gas or liquid lines, blanketing dangerous areas and for many other industrial uses involving the handling or storage of explosive materials.

R-C Inert Gas Generators are compact, simple and inexpensive to operate, with either oil or gas as fuel. They are available in capacities from 1,000 cfh to 50,000 cfh, with characteristics to match specific requirements.

Where even a relatively low explosion hazard exists, one incident might produce a disastrous fire. Ask for details on how such dangers may be averted with R-C Inert Gas Generators.

ROOTS-CONNERSVILLE BLOWER DIVISION
1152 Michigan Ave., Connersville, Indiana



Installation of three R-C Inert Gas Generators similar to this one helped one large plant save $6,000 per month insurance premiums, as well as substantially reduce danger of production losses caused by explosion or fires. Capacity of each unit, 6,000 cfh.

Reg. U. S. Pat. Off.

ROOTS-CONNERSVILLE BLOWER
A DIVISION OF DRESSER INDUSTRIES, INC

Quality Craftsmanship

Since 1907—for 45 years—The Cincinnati Gear Company has been producing ***Gears—Good Gears Only.*** Expert, efficient craftsmen, working with top quality materials, have built for The Cincinnati Gear Company an enviable reputation. So, no matter what your gear requirements might be—no matter how large or small the order—write, wire or call for estimates, prices and complete details.

Spur
Helical
Worm
Herringbone
Internal
*Coniflex Bevel
Spiral Bevel
Spline Shaft

*Reg. U. S. Pat. Off.

THE CINCINNATI GEAR COMPANY

"Gears . . . Good Gears Only"

Wooster Pike and Marlemont Ave. • Cincinnati 27, Ohio

ELEVENTH
Air Conditioning Exposition
INTERNATIONAL HEATING & VENTILATING EXPOSITION
INTERNATIONAL AMPHITHEATRE, CHICAGO
JANUARY 26-30, 1953

COME TO CHICAGO

to see

NEW *Ideas . . . Products . . . Methods . . . Trends*

in

HEATING VENTILATING AIR CONDITIONING

For 5 full days, Chicago's huge International Amphitheatre will be bulging with stimulating ideas and up-to-the-minute, cost-saving information on HEATING . . . VENTILATING . . . and AIR CONDITIONING.

More than 300 exhibits will display the newest equipment and parts developed for conditioning air and the latest methods used in adapting them to all types of industrial, commercial, and residential requirements. Design, application, operating, and service engineers, all will have an exceptional opportunity to discuss plans, problems and requirements with the technical experts who will be staffing the exhibits . . . will come away with more practical dollars-and-cents ideas than could possibly be acquired anywhere else in so little time.

mark this date NOW

JAN. 26-30

ATTEND and BENEFIT
from this 5-day exposition of ideas and progress

Auspices of the American Society of Heating and Ventilating Engineers

Management International Exposition Company

216 RECORDING MECHANICAL COUNTERS

Streeter-Amet Co.—New illustrated bulletin on latest recording mechanical counters actuated by electrical impulses. Many new uses for these recording counters are depicted for industry as well as for science. Machine shops, airports, hospitals, scientific laboratories are among the wide range of fields where they can be used with profit. Variable components multiply the recording possibilities for a variety of counting and timing jobs.

217 TEMPERATURE AND PRESSURE REGULATORS

Fulton Sylphon Div.—Robertshaw Fulton Controls Co.—Well illustrated Catalog A describes the Fulton Sylphon line of regulators for temperature and pressure control. This catalog also gives technical information relating to relief valves, pump governors, safety and vacuum regulators. In all there are over 200 pages of illustrations, data, and drawings.

218 FRACTIONAL HORSEPOWER VARI-SPEED MOTODRIVE

Reeves Pulley Co.—A 12-page bulletin, M-513, describes the Reeves fractional HP Vari-Speed Motodrive. It shows standard assemblies, dimensional diagrams and complete rating tables of this unit which has a speed range of 10:1 in $\frac{1}{4}$ to $\frac{3}{4}$-hp sizes. The unit can be equipped with manual control, extended control, electric remote, or mechanical automatic control.

219 FORK TRUCK OPERATION

Hyster Co.—A 24-page manual for use in training lift-truck operators contains information not only about the operation of a lift truck, but also preventive maintenance, safety, and basic materials handling. Drawings for setting up an obstacle course are also included.

220 VARIABLE SPEED DRIVES

Reeves Pulley Co.—A new 12-page bulletin, C-509, describing the basic operating principals of the Reeves variable speed drives contains rating tables and dimension drawings and illustrates variable-speed drives ranging from $\frac{1}{4}$ to 87 hp with stepless speed changes within ratios from 2.1 to 16.1.

221 PRESSURE AND TEMPERATURE REGULATORS

Spence Engineering Co., Inc.—A new 32-page booklet contains useful information about pilot-operated pressure and temperature regulators. Illustrated with photos, charts, and tables, it discusses main valves, controls, and strainers, gives capacity and flow data as well as dimensions and weights.

222 WATER SURFACE SELECTION

John J. Nesbitt, Inc.—Complete 36-page catalog, No. 256, explains the fundamentally correct method for selecting water surface for air cooling and dehumidifying with cold water or heating with hot water without the use of arbitrary constants or empirical formulas. Aids in the selection of Nesbitt surface types for any particular installation requirements, including sizes, capacities, etc.

223 POWER TRANSMISSION EQUIPMENT

Lovejoy Flexible Coupling Co.—Illustrated Catalogs. Flexible couplings: Cushions changed without shutdown. No lubrication needed. $\frac{1}{3}$ to 2500 hp. Variable Speed Pulleys: Change speed while machine is running. Ratios to 3 to 1. Fractional to 8 hp. Select-O-Speed Transmissions: Wide speed adjustment. Ratios to 10 to 1. Fractional to $7\frac{1}{2}$ hp. Universal Joints: Precision ground alloy steel. 13 sizes. Bores $\frac{1}{4}$ to 2". Lengths 2 to $10\frac{1}{2}$".

224 WORM GEARS

Cone-Drive Gears Div., Michigan Tool Co.—Quick reference bulletin 789-50 covers standard double-enveloping gear sets, reducers, fan cooling attachments, mountings, and shafts carried in stock. The bulletin has a condensed table indicating the wide range of horsepower which can be carried by these ultra-compact gear sets and reducers. Horsepower ranges from fractional to over 500 hp. Ratios range from 5/1 to 70/1. Center distances range from 2 to 18 in., corresponding to gearsets of from 3 in. to close to 30 in. in conventional gear designs from the standpoint of mechanical load carrying capacity.

225 CEMENTED CARBIDE

Carmet Div., Allegheny Ludlum Steel Corp.—a 32-page illustrated catalog tells how Carmet is made and gives the metallurgy of cemented carbide. Contains information on Carmet for machining steels, cast iron, nonferrous metals, nonmetallics, punches, dies, etc.

226 PACKAGED STEAM GENERATORS

Cyclotherm Div. United States Radiator Corp.—Catalog No. 52 describes and illustrates the new Cyclonic combustion flame control that reduces heating surface requirements from 5 to just 3 sq ft per boiler hp and delivers a guaranteed minimum efficiency of 80%. Also lists data on Cyclotherm 2-pass generators, fiberglas insulated, from 18 to 500 hp, 15 to 200 psi operating pressure.

227 EXTRUDED ALUMINUM

Aluminum Company of America. Booklet contains a discussion of design and production advantages of aluminum extrusions. Illustrations of the way several extruded shapes can be combined to simplify assembly and reduce costs. Data on size and shape limitations, alloys, section thickness, tolerances, die costs.

228 AUTOMATIC CONTROLLERS

Foxboro Co.—Bulletin No. 461 presents the many unusual features of the Model 40 Controller, and shows the various available types of this well-known member of the extensive Foxboro line of industrial instruments. Other bulletins cover individual subjects including indicating, recording and controlling instruments of various kinds, whether pneumatic, electric or electronic.

229 STAINLESS STEEL FABRICATION

U.S. Steel Subsidiaries.—136-page handbook describes stainless steels produced by U.S. Steel, lists all properties, and provides complete details on end use and fabricating practices. Includes data on welding, riveting, soldering, joint design, machining, cutting, forming, annealing, pickling, and surface finishing and protection.

230 VALVES

Wm. Powell Co.—New 589-page No. 11 General Catalog describes in detail the standard Powell bronze and iron valves, quick-opening valves, and all-iron valves.

231 BULK FLOW CONVEYERS

Link-Belt Co.—28 page book No. 2475 contains complete engineering data on Bulk-Flo conveyers and elevators. Over 150 materials are analyzed for such characteristics as weight, size, flowability, abrasiveness. The Bulk-Flo moves free-flowing materials gently in a continuous mass by means of endless chain with spaced solid flights in a close-fitting enclosure.

232 ELECTROSTATIC PRECIPITATORS

Koppers Co., Inc.—Precipitator Dept.—Folder describes Koppers Elex electrostatic precipitators in features and performance. Specific operating results are given as well as suggested applications in nuisance elimination, cleaning of process gases, or recovery of valuable products.

233 GENERAL PURPOSE TURBINES

Westinghouse Electric Corp.—Booklet No. B-3896. The type-E turbine will perform a number of jobs well even under abnormal operating conditions. Designed for economy and dependability in continuous or stand-by operation. An excellent means of effecting steam expansion without loss of energy. Fully illustrated and diagrammed.

234 VALVES, PIPE FITTINGS, ETC.

Kennedy Valve Mfg. Co.—Catalog covers full Kennedy line of iron and bronze valves; malleable iron, cast iron and bronze pipe fittings; fire hydrants and indicator posts. It gives detailed information on design, specifications, selection, and application. Special valves and accessories also treated in detail.

235 RETAINING RINGS

Waldes Kohinoor, Inc.—A new 52-page catalog covers Waldes Truarc retaining rings, including 28 pages of engineering and specification charts, 6 pages of field applications and case histories, 18 pages devoted to Truarc pliers, assembly, and accessory tools, and other invaluable information pertaining to the most advantageous use and selection of Truarc retaining rings.

236 FLEXIBLE, SWIVEL, SWING, AND REVOLVING JOINTS

Barco Mfg. Co.—For piping and lines conveying steam, oil, air, gasoline, water, chemicals, including corrosive acids and alkalies, and other fluids or gases. Types for pressures up to 750 psi, steam, and 7500 psi hydraulic. Complete range of sizes. Catalogs No. 215 "Flexible Ball Joints"; No. 265 "Rotary Swivel Joints"; No. 400 "Barco Swing Joints"; No. 300 "Revolving Joints."

TO
ELECTRO-MECHANICAL
ENGINEERS
AND
DESIGNERS

with experience in

SMALL, PRECISION DEVICES

HUGHES RESEARCH AND DEVELOPMENT LABORATORIES, one of the nation's leading electronics organizations, is now creating a number of new openings for qualified electro-mechanical engineers and designers in important phases of its operations.

HOW TO APPLY

Write today to address below, giving details of qualifications and experience. Assurance is required that any relocation of an applicant will not cause disruption of an urgent military project.

THE COMPANY

The Hughes Laboratories, located in Southern California, are presently engaged in the development and production of advanced radar devices, electronic computers and guided missiles.

THE OPPORTUNITIES

Opportunities are offered for men who will perform interesting work on development of intricate new devices in close association with outstanding scientists. Activities will embrace a variety of challenging problems requiring originality and affording unusual possibilities of progress in learning.

FIELDS OF WORK

The work includes such fields as those involving Servo Mechanisms, Computers, Microwave Tubes, Pulse Circuitry, Solid-State Physics, Miniaturization, Antennas—Waveguides, Heat Transfer, Hydraulics—Gyros, Test Equipment, Subminiaturization, Stress Analysis, Instrumentation, Structures, and Precision Production Mechanisms.

YOUR FUTURE

Working experience in advanced techniques employing the above fields will increase your value to the Company as it further expands in development of electro-mechanical devices. Large-scale use of electronically controlled systems in business and industry is a certainty within the next few years.

HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES

ENGINEERING PERSONNEL DEPARTMENT

CULVER CITY, LOS ANGELES COUNTY, CALIFORNIA

Build your future at BOEING!

THE revolutionary B-47 medium jet shown above, and the new, still-classified B-52 eight-jet heavy bomber, are two striking examples of Boeing engineering leadership. Other Boeing engineering projects include secret guided missiles programs, nuclear-powered aircraft, and exploration of supersonic flight.

If you are an engineer interested in exciting, long-range projects with a future, look into Boeing opportunities.

Here at Boeing you'll share the prestige of Boeing leadership that has been growing for 35 years.

There are opportunities at Boeing right now for experienced and junior engineers in all fields, for aircraft

- DESIGN
- DEVELOPMENT
- RESEARCH
- PRODUCTION
- TOOLING

also for servo-mechanism and electronics designers and analysts, and for physicists and mathematicians with advanced degrees.

Work in Seattle or Wichita. Boeing provides a moving allowance, offers special training, a salary that grows with you—and a future of almost limitless range. You'll be proud when you say, "I'm a *Boeing* engineer!"

Write today to address below or use coupon

JOHN C. SANDERS, Staff Engineer—Personnel
Dept. M-11
Boeing Airplane Company, Seattle 14, Wash.
Engineering opportunities at Boeing interest me. Please send me further information.

Name _____
Address _____
City and State _____

237 OIL SEALS

Johns-Manville—Clipper Seal brochure describes complete story of this precision-molded oil seal that provides efficient bearing protection at low cost. Includes photographs and diagrams of typical installations; shows how various lip designs provide choice of bearing surfaces; how its simple one-piece construction allows greater freedom in designing oil-seal cavities.

238 EXPLOSIONPROOF AIR VALVE

Bellows Co.—Folder describes and pictures a complete "packaged", explosionproof, low-voltage electrically controlled air-powered air valve. Built into one integral unit is a four-way directional slide valve, solenoid control units, and piston rod speed regulators. The valve meets fully Group D, Class 1 Standards for wiring in hazardous locations as established in the National Electric Code of the National Board of Fire Underwriters.

239 STEAM AND LIQUID CONTROL EQUIPMENT

O. C. Keckley Co.—Catalog No. 53 contains 60 pages of illustrations and engineering data on precision pressure regulators, temperature regulators, float valves, diaphragm valves, solenoid valves, water gages, float boxes, safety and relief valves, strainers, etc. Drawings, layout diagrams, dimensions, and capacity tables are included.

240 FEEDWATER REGULATORS

Copes—Vulcan Div.—Continental Foundry & Machine Co.—New Bulletin No. 491 concisely describes and tabulates engineering data for COPES simple-level, flowmatic, and balanced flow feedwater controls, also for differential, pump governor, pressure reducing, and balanced valves, also for desuperheaters, liquid level controls, and hi-lo water alarms.

241 ROTARY PRESSURE JOINTS

Seamlex Co., Inc.—New Bulletin 5500 describes "Seamlex" rotary joints with triple protection against leakage. Principal features: External screw adjustment to compensate for wear of seal without removal of joint; floating rotary seal balances misalignments; pressure-equalizing chamber prevents excessive wear of rotary seal. Conveys liquids and gases. Made in syphon-and through-flow type. Pipe sizes 1/2 to 1 1/2 in.

242 COOLING TOWERS

Marley Co. Inc.—Bulletin DFA-52 introduces an entirely new design tower for capacities up to 1800 gpm. The Double-Flow Aquatower offers exceptional simplicity of construction and operation. Pumping head is very low since tower height is approximately one third that of other induced draft towers of similar capacities. Seven standard sizes are offered in either all-steel or wood-framed with asbestos cement board casing.

243 SPEED-MEASURING INSTRUMENTS

James G. Biddle Co.—Bulletin 35-50 describes resonant reed, centrifugal, and chronometric types of speed-measuring instruments. 28 pages devoted to the selection, operation, and illustration of Frahm, Jagabi, Jones, and Dr. Horn instruments. Also featured are repair and engineering services available.

244 ROLLER BEARINGS

Shafer Bearing Co.—Engineers and specifiers of industrial roller bearings and mounted units will be interested in 56-page catalog 51. Illustrates and describes full line of roller bearing units plus unmounted roller bearings. Design features such as conical rollers operating between matched convex races, and the advantages of this design are fully discussed. Of interest are larger models of bearing units with standard shaft sizes now available up to 5-in. diam. Also contains complete engineering and load rating data and illustrates many product applications.

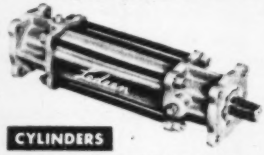
245 SEPARATOR FILTERS

Jas. A. Murphy & Co., Inc.—The Murphy ASF-Aftercooler separator filter combination complete with zip trap is designed to do a complete job of cooling, cleaning, and drying compressed air before it enters the distributing lines. ASME designed and stamped, in sizes 50 to 2500 cfm.

246 WELDING FITTINGS AND STEEL FLANGES

Tube Turns, Inc.—Chart of Pipe and Fittings Materials. Quick-reference chart covering ASTM and other specifications, chemistry, service temperature limits and welding data on carbon, intermediate alloy, stainless and special analysis steels. Dimensional Data and Weights. Folder of man-

Ledeen PNEUMATIC & HYDRAULIC Equipment



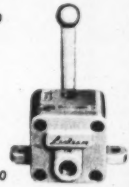
CYLINDERS

For air, oil, water, gas or steam operation—in standard and special diameters and stroke lengths.

Write for Bulletin 500

VALVES

For operating air and hydraulic cylinders and motors, single and double acting. Hand, foot, power and solenoid operated.



Write for Bulletin 1000

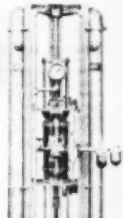
VALVE ACTUATORS

For power operation and remote control of line valves. Adaptable to most any make, size and type of valve, to operate against any line pressure, for any fluid medium, with any pressure.

Write for Bulletin 512

AIR-HYDRAULIC PUMPS

High pressure oil, from plant air supply. For clamping, drawing, forming, testing and other operations requiring long high pressure cycles without vibration or overheating. Ready for connection to plant air and hydraulic lines.



Write for Bulletin 4000

VALVES • CYLINDERS
AIR-HYDRAULIC PUMPS & BOOSTERS
VALVE ACTUATORS • AIR HOISTS

Ledeen Mfg. Co.
1600 San Pedro
Los Angeles 15, Calif.

size tables giving dimensional information on Tube-Turn welding fittings from ½ to 30 in. in standard weight and extra strong, and flanges in all sizes and weights. Allowable working pressures. Booklet of pressure tables covering complete line Tube-Turn welding fittings for power piping, oil piping, heating piping, gas piping, refrigeration piping.

247 VACUUM DEAERATOR

Permutit Co.—Bulletin No. 3698, 8 pages, describes the manufacturer's vacuum deaerator and how the unit removes oxygen and free carbon dioxide from water so as to protect piping, steel tanks, and other equipment from corrosion.

248 TANKS AND TOWERS

W. E. Caldwell Co.—New 50-page catalog No. 58 with illustrations, data, and prices on wood and steel tanks and towers for all purposes, as well as tank agitators, stirring devices, tank heaters, float valves, and many other accessories.

249 DRAFTING-MACHINE SCALES

Universal Drafting Machine Corp.—Bulletin gives complete information on the advantages of this extremely accurate, ground from the solid, aluminum scale, and in addition provides a valuable chart of ¾ size actual scale photographs showing all the standard Duraline Scale graduations commonly used by engineers, draftsmen, architects, and designers. It also provides an explanation of scale terminology in general use—to aid buyers when writing for information on specially graduated scales for special uses.

250 POWER SUPPLIES

Bogue Electric Mfg. Co.—An 8-page bulletin illustrates and describes Bogue 440-cycle power supplies. Shows typical oscillograms and wave shape. Contains ratings, weights, and dimensional charts for motor-generator sets applicable to many 400-cycle power requirements.

251 VIBRATION CONTROL SYSTEMS

Lord Mfg. Co.—The originators of vibration and shock control through use of rubber bonded to metal offers complete engineering and product manufacturing services. General catalog No. 900 describes basic types of commonly used products and methods of application. Company designs and manufactures vibration control systems for all types aircraft and electronic machinery and equipment.

252 NONABSORBENT INSULATION

Insul-Mastic Corp. of America.—32-page catalog describes a protective coating and insulation combined. It is spray applied in coating form ¼ in. thick. It stops 65% of heat loss or controls condensation. Prevents corrosion by repelling moisture. Temperature range −40 F to 300 F.

253 PYRITES CONVEYER SYSTEM

United Conveyer Corp.—Bulletin describes conveying system for disposal of pyrites from coal pulverizers. Particularly suitable for installations in the larger industrial and central-station plants. Pyrites are picked up from mill reject outlet and conveyed hydraulically in single operation to final disposal point, which can be ash pit hopper, fill area, or overhead dewatering storage bin.

254 SHIPPING CONTAINERS

Pressed Steel Tank Co.—New catalog describes complete line of returnable-type shipping containers for liquids and solids. This includes steel, stainless steel, nickel, monel, and aluminum drums and barrels. Literature and catalog also available describing complete line of lightweight compressed gas cylinders, shapes, and shells.

255 RADIAL-THRUST ROLLER BEARINGS

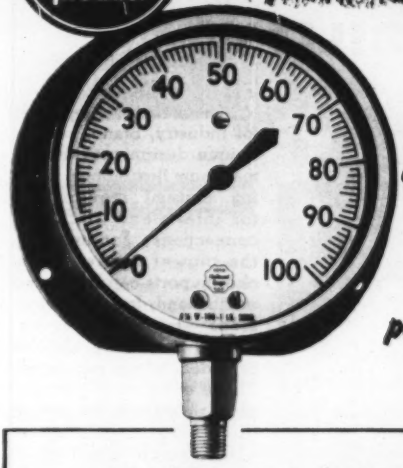
Shafer Bearing Corp.—Latest 56-page catalog gives complete specifications of Shafer ConCaVex radial-thrust roller bearings, featuring full capacity self-alignment within the bearing itself. Available in unmounted single and double-row style, or in double-row mounted units as follows: Pillow blocks, flange units, cartridge units, flange-cartridge units, duplex units, take-up units, take-up and frame units. Mounted units available in normal duty, standard heavy duty, and adapter mounting types as well as in "Specials."

256 VAPOR-MIZER TANKS

Graver Tank & Mfg. Co., Inc.—A new 12-page booklet describes the operation of the Graver Vapor-Mizer in combating gasoline evaporation losses during storage, and covers single and multiple-tank installations, design features, and fittings. An example based upon current API studies shows the economies possible in using a Graver Vapor-Mizer manifolded system.

an ACCO product

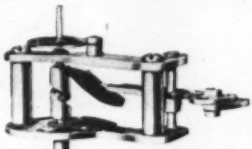
HELICOID



The gage that retains its original accuracy longer, lasts longer, costs less per gage, per year

• Only HELICOID GAGES have the Helicoid Movement . . . tested and proved in years of hard service . . . a simple cam and roller design that does not have any teeth to wear out. Helicoid Gages cost less in the long run because they give long, trouble-free service with a minimum of maintenance.

Helicoid Gages can be furnished with ACALOY cases in flanged (illustrated), flangeless or flush mounting (round or square); also in phenol—with black, white or phosphorescent dials; phosphor bronze, alloy steel, stainless steel or K Monel Bourdon tubes; in pressure, vacuum or compound types; in a full range of pressures: all with the Helicoid stainless movement.



FOUR HELICOID FEATURES

1. Stainless Steel Helicoid Roller (no gear teeth)
2. Stainless Steel Hair Spring
3. Long Life Cam (no gear teeth)
4. Corrosion Resistant Link and Screws

Write today for the Helicoid Catalog

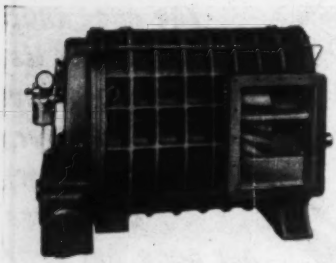
ACCO

HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE

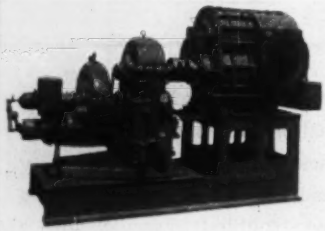
929 Connecticut Avenue • Bridgeport 2, Connecticut

HELICOID *Pressure • Vacuum* GAGES

STANDARDAIRE BLOWERS *for easy* ADAPTABILITY



Standardaire Blower with side intake and discharge.



Standardaire Blower with turbine and gear drive unit.

Standardaire Blower with side intake and end discharge.

To meet the specific needs for industry, Standardaire's unique design provides for maximum flexibility in meeting unusual requirements for intake and discharge connections. For example, the blower intake or discharge ports can be located on the end, top, bottom or sides···· two intake or discharge ports may also be provided when necessary. These exclusive features, plus provisions for direct drive by a power unit of your choice, are typical examples of Standardaire's adaptability.

Standardaire Blower with single top intake and two side discharge ports.

Installation showing three Standardaire Blowers.

Write . . .

Read Standard Corporation, Dept. F-60
370 Lexington Ave., New York 17, N.Y.
BLOWER-STOKER DIVISION

AXIAL FLOW STANDARDAIRE BLOWER

READ STANDARD
CORPORATION

NEW YORK · CHICAGO · YORK · LOS ANGELES

257 FINTUBES

Brown Fintube Co.—Latest data on construction, application, and engineering of Brown Integral "one-piece" Fintubes, is given in a new bulletin, including comparisons of external surface of bare pipe or tubing with longitudinally finned pipe or tubing.

258 TECHNICAL BOOKS

John Wiley & Sons—Publishers of scientific and technical books. 1953 catalog available, containing descriptions of over 1300 books in science and engineering. Of particular interest to engineers are the following recently published Wiley titles: "Fatigue & Fracture of Metals," a symposium edited by Murray, Sechler's "Elasticity in Engineering," Eshbach's "Handbook of Engineering Fundamentals," Hansen and Chenea's "Mechanics of Vibrations," Thring's "Science of Flames and Furnaces," Johnson's "Nomography and Empirical Equations," Delmonte's "Plastics Molding," and Begeman's "Manufacturing Processes."

259 INSTRUMENTS—RECORDERS

Brush Development Co.—Brush oscillographs, amplifiers, acoustical instruments, recording analyzers provide immediately usable, permanent records on electrical, mechanical, or acoustical investigations on items such as surface finish, textile fiber uniformity, d-c or a-c voltages or currents, strains, displacements, light intensities, temperatures, other static or dynamic conditions.

260 GEAR SPEED REDUCERS

D. O. James Gear Mfg. Co.—Catalog 47-B contains 72-page price list and selection table and important information on gear speed reducers, motorized gear speed reducers, motor reducers (A packaged unit assembled on base plate with coupling). Each type in 35 sizes, ratio 10:1 to 1200: 1, 3/4 to 75 hp.

261 ELECTRIC WELD TUBE MILLS

Yoder Co.—68-page book of information on the mechanics as well as the economics of converting coiled strip into welded mechanical tubing, conduit boiler tubes, furniture tubing, etc.; physical properties of products, end uses, output per man hour; materials suited for tube making; scrap losses, welding speeds and power consumption; continuous feeding; formula for strip widths, etc.

262 DUST-CONTROL EQUIPMENT

Dracco Corp.—A new 40-page bulletin No. 800 presents complete technical information on the extensive line of Dracco dust-control equipment. Multi-Bag Filters, Uni-Filters, Dustomatic Filters, "DH" Filters, and Whirl-Clones for the control or recovery of all kinds of industrial dust are features. Also included are explanations of operational features, specifications in tabular form, and installation photographs.

263 CORROSION-RESISTANT VALVES

Rockwell Mfg. Co.—Catalog V-217, "Rockwell-Built, Nordstrom Corrosion Resistant Valves," designed specifically for use in the process industries, describes types, operation, and features of Nordstrom corrosion resistant valves. Tables are included listing approximately 175 different chemicals, with special reference to their recommended alloys and lubricants. Typical chemical analyses are made of bronze, Mercoloy, Ni-Resist, stainless steel, nickel, mouel, and Hastelloy. In addition to size and specification tables, over 100 illustrations show valve sizes, types, and practical applications in the process industries.

264 GEARMOTORS

Westinghouse Electric Corp.—Folder B-5296 describes what to look for in a gearmotor. This includes a split housing, antifrication bearings, taper-hardened single-helical gears, adequate breather, positive oil seals, and ample lubrication.

265 OIL FILTERS AND OILING DEVICES

Wm. W. Nugent & Co.—A set of six Bulletins in a binder. Each bulletin profusely illustrates and describes a Nugent product such as: Gravity Liquid Filters; Pressure Liquid Filters; Oiling Devices; Sight Feed Valves; Sight Flow Indicators; Compression Union Pipe Fittings; Automatic Oil and Water Separating Tanks; Oiling and Filtering Systems. These products are for large Engines, Pumps, Compressors, Gear Reduction Units, etc., and all kinds of machinery used in Rolling Mills, Cement Mills, Power Plants, both Stationary and Marine, and Railroads.

266 CHEMICAL PUMPS

Goulds Pumps, Inc.—Bulletin 725.3 describes chemical centrifugal pumps available in 9 sizes with capacities up to 720 gpm and heads up to 200 ft. Stuffing box under suction pressure only,

prevents leakage and assures long packing life. Parts are interchangeable. Bearing construction is such that clearance between impeller and case can be adjusted to compensate for wear. Choice of materials of construction.

267 WATER-TREATING EQUIPMENT

Hungerford & Terry, Inc.—Bulletin BFT-1 describes and illustrates zeolite and cold process softening, partial and complete demineralization; any of which is available for manual or automatic operation on any water supply for any water requirements. Equipment for tailor-made water is described.

268 VARIABLE-SPEED DRIVES

General Electric Co.—A 26-page manual helps select the right kind of adjustable-speed drive for a specific need. A handy drive chart is included to give a detailed comparison of the complete line of G-E adjustable-speed equipment—the ACA motor, speed variator, Thy-mo-trol, electronic speed variator, and others.

269 WELDING

American Welding & Mfg. Co.—Bulletin CA-50 discusses fabrication by controlled technique flash-butt welding. Illustrated are a variety of welded rings and bands and weldments. The bulletin discusses research engineering, fabrication technique, scientific inspection, and precision machining with many successful welding problems.

270 ASH HANDLING SYSTEMS

Beaumont Birch Co.—"Answers to Your Questions on Ash and Flyash Handling Systems," includes sections on hydraulic ash handling, pneumatic ash and flyash handling systems. Illustrated by drawings and schematic presentations of typical arrangements for each type of system. Discusses elements, problems, and advantages of each system.

271 MOLDED CUPS

Garlock Packing Co.—Information on molded cups for pump pistons, hydraulic service, and pneumatic equipment is available in a 6-page bulletin. Folder contains illustrations of various types of molded cups, service data, and a complete list of sizes and part numbers. Typical applications are also shown.

272 STEAM TURBINES

Terry Steam Turbine Co.—Bulletins in looseleaf form which cover a complete description of Terry solid wheel turbines with cross section drawings of typical units for both moderate and high steam pressure conditions: a description of the Terry axial flow impulse, both single stage and multi-stage; Terry gears which are used for speed increasing and speed reducing.

273 STEAM TRAP PROBLEMS

V. D. Anderson Co.—Bulletin No. 151 entitled "Solving Steam Trap Problems," contains 36 pages of illustrations, drawings, and charts, describing the importance of trap selection and showing application for various industries.

274 OIL AND GREASE SEALS

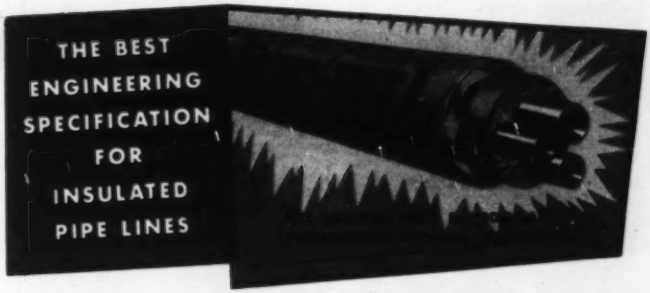
Garlock Packing Co.—Complete information on Klozure oil and grease seals for bearings is available in a 100-page catalog No. 10. Contains illustrations of all types of Klozures, typical applications, and a complete list of sizes and part numbers. In addition, this catalog describes Garlock's mechanical pressure seals for rotary shafts.

275 HEAT EXCHANGERS

Superior Combustion Industries, Inc.—Catalog describes heat exchangers in relation to their use for heating and cooling, condensing, and for evaporating. The bulletin presents the basic components—heads, shells, and tube bundles—in a manner which simplifies the selection and specification of Superior heat exchangers for any heat-transfer application. Special attention is given to tank heaters and fuel-oil heaters.

276 STEEL TANKS

Chicago Bridge & Iron Co.—An 8-page booklet, "The Hortonsphere," describes the advantages of storing highly volatile liquids and gases in Hortonspheres under pressure. Tables of sizes are included in the booklet. Hortonspheres for the storage of liquids range in capacity from 1000 to 30,000 bbl for operating pressures of about 30 to 215 psi. Hortonspheres for gas storage have been designed in standard sizes from 32 to 80 ft in diam for operating pressures of 30 to 150 psi.

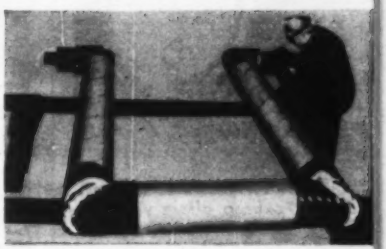


COMPLETE PROTECTION

Ric-wiL HEL-COR Units are designed for severe service conditions. The strong, shock-proof housing is 16-gauge Armco ingot iron, spirally-corrugated, hot-dipped galvanized, and rust-proofed "Bonderized." Outside is given a ⅛" thick covering of high-melting point asphalt and asbestos felt, and inside coated with phenolic resin, baked-on — a multiple layer of protection against moisture and corrosion.

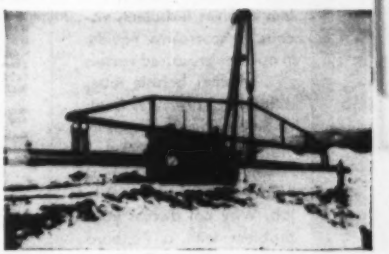
CERTIFIED WELDING

Built by skilled craftsmen, all Ric-wiL systems are designed and welded to comply with the requirements of the A. S. M. E. Code for Pressure Piping, and we are authorized to apply the appropriate Code symbols. Piping and conduit are rigidly inspected and tested before leaving our factory — your assurance of trouble-free piping performance.

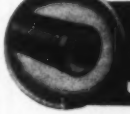


PREFABRICATED UNITS

All parts and fittings, including complete expansion loops or packless-type joints, are delivered to job site in easily-handled units of sound engineering design — eliminating many installation steps entirely and lowering final costs. These versatile units may be safely installed under city streets, railroad tracks, or suspended overhead.



Ric-wiL Systems range in size from 6" conduits to giant 84" diameter Utilidors designed to carry all utility services. Put Ric-wiL's broad experience to work for you — ask us for latest literature or discuss your next piping project with a Ric-wiL representative.



THE RIC-WIL COMPANY

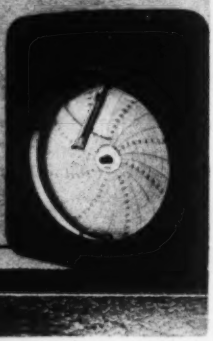
Mfgrs. Insulated Piping and Conduit Systems

UNION COMMERCE BLDG. • CLEVELAND, OHIO

LEADERS IN INSULATED PIPING PROTECTION

Complete Line of Instruments to measure and control

LIQUID LEVEL



Foxboro offers you *unbiased* recommendations on instruments to indicate, record, or control liquid level. Whether your problem involves turbulent, viscous, or corrosive liquids, in open or pressured vessels . . . whether bubble tube, differential pressure, float, or diaphragm box measuring systems are required — Foxboro offers the most efficient instruments for the job. Why not discuss your problem with a Foxboro engineer? Write **The Foxboro Company, 9611 Norfolk St., Foxboro, Mass., U.S.A.**

FOXBORO
Instruments

277 STEEL PROPERTIES

Latrobe Steel Co.—Folder shows the properties and general applications of 5 "Desegatized" Hi Carbon-Hi Chromium die steels. The folder graphically shows the comparative wear resistance, toughness, and size rigidity of these five steels plus impact strength and hardness diagrams.

278 FLEXIBLE COUPLINGS

Thomas Flexible Coupling Co.—New catalog 51 in 9 × 11" binder gives latest engineering information on Thomas Flexible Couplings. It shows their complete lines of Standard type of all metal flexible couplings for Power Transmission on heavy-duty impulse loads such as Diesel-driven compressors, as well as for smooth loads such as motor drive centrifugal pumps. Grouped and indexed for quick reference. Special section shows couplings designed for specific purposes with photos of typical installations.

279 SPREADER STOKERS

Detroit Stoker Co.—Bulletin No. 890 describes a spreader stoker having overthrow rotors that provide exceptionally uniform fuel distribution. Available with stationary, hand-dumping, and power dumping grates. Many sizes assure efficient application to all types of boilers and steam generators. Burns all grades of bituminous coal, lignite, and various kinds of wood, and other refuse.

280 VALVES AND REGULATORS

Watts Regulator Co.—Catalog No. 52 contains typical and popular plumbing and heating safety valves and controls manufactured. Included are temperature and pressure relief valves, vacuum relief, and hot-water tempering valves for domestic hot-water supply systems.

281 PACKAGED STEAM PLANT

Superior Combustion Industries, Inc.—Catalog No. 403 contains facts about Superior steam generators. Its 22 illustrated pages demonstrate the "how" and "why" of Superior steam generators' long-lived, high efficiencies. Easily-read tables provide engineers with essential data and dimensions.

282 GAS AND AIR LINE SNUBBERS

Burgess-Manning Corp.—Bulletin describes features and applications of Gas and Air Line Snubbers, specifically designed to reduce pipe-line surging and the damaging vibration which it produces, and to eliminate troublesome metering due to the pulsating flow of compressible fluids from compressors, pumps, or blowers. These Snubbers may be used for suction or discharge services. They find wide application in oil and gas production, oil and gas well repressuring, gas transmission, petroleum refining, and the petrochemical process industry.

283 ELECTRIC BRAKES AND CLUTCHES

Warner Electric Brake & Clutch Co.—Catalog No. 6069 contains information on complete line of electric brakes and clutches for industrial application. Contains general description, torque values, and general data pertaining to all sizes. Complete capacity tables, dimensions, and specifications are included.

284 HORIZONTAL END SUCTION PUMPS

Peerless Pump Div.—Food Machinery & Chemical Corp.—Bulletin B-2300 describes complete line of horizontal end suction general-purpose pumps available in close-coupled electric and belted models. Handle capacities up to 5500 gpm and heads to 260 ft. Motor sizes are available from 1/4 to 150 hp. Compact, efficient, durable, and versatile pumps for water and alkaline fluids.

285 CENTRALIZED LUBRICATION

Farval Corp.—Bulletin No. 25 provides a complete explanation of the Farval Dualine system of centralized lubrication and its advantages as a means of saving oiling labor, lubricant, bearing expense, and production time for various types of heavy industrial equipment. Its 16 pages liberally illustrated with photographs, drawings, and diagrams.

286 FLEXIBLE COUPLINGS

American Flexible Coupling Co.—Catalog 501 contains 12 pages of technical data on flexible couplings and features the "Ameri-gear" and "American" couplings. Includes specification data, cutaway drawings, and plan drawings, together with rating tables, construction features, and dimension factors.

287 OIL AND GAS BURNERS, STOKERS

Iron Fireman Mfg. Co.—New 16-page, 3-color general catalog No. 2129 presents the complete line of Iron Fireman automatic firing equipment, including industrial and commercial oil and gas burners, combination oil-gas burners, pneumatic spreader and underfeed stokers for power and heating applications. Includes descriptions, illustrations, engineering data, and Selector Guide-Capacity Tables covering all equipment.

288 BOILER-WATER COLUMNS

Reliance Gauge Column Co.—New bulletin No. 516 describes boiler-water columns and gage equipment such as the original "alarm" water columns, remote reading water-level gage, liquid-level alarms, illumination equipment, gage valves, gage cocks, etc.

289 SPACE HEATERS

Dravo Corp.—Bulletin No. 526 describes Dravo "Counterflo" direct-fired space heaters in a range of gas- or oil-fired models with outputs from 400,000 to 2,000,000 Btu per hr. A comparison chart shows that steel requirements for these heating systems can be reduced 50 to 70 per cent through the use of direct-fired warm air heaters.

290 HY-VO CHAIN DRIVE

Morse Chain Co.—Complete catalog describes the Hy-Vo chain drive. The catalog includes (1) a basic discussion of operating principles of chain drives, (2) highlights of Hy-Vo's new design principles, (3) description of Hy-Vo's capacities in high-speed heavy-duty field, (4) speed ranges and service factors, (5) installation, lubrication, and maintenance data.

291 DUST COLLECTORS

Green Fuel Economizer Co.—16-page Bulletin describes "Aerodyne" dust collector which operates on the aerodynamic principle of separation. Suitable for steam and power plants, cement, and other process plants, foundries, etc.

292 PUMPS AND SEPARATORS

Kraissl Co.—Catalog in loose-leaf form gives data on products and indicates as briefly as possible the important features of each product or item. The recent loose-leaf additions to this catalog include the new Kraissl class 34 series circulators for both horizontal and vertical operation. Other data sheets describe the complete line of Kraissl separators including both strainers and filters.

293 SLUG BUSTER SNUBBER

Burgess-Manning Co.—Bulletin describes the features and applications of the new SDG Slug Buster Snubber designed for use in the petroleum, chemical, and industrial fields. The SDG Snubber is designed to reduce noise from engine exhausts and vacuum pump discharges to the noise level of the surrounding industrial area.

294 COMPRESSORS

Frigidaire Div. of General Motors Corp.—3 to 5-hp reciprocating-type air-cooled and water-cooled compressors are shown. Specifications and Btu refrigeration capacities per hour are given.

295 RUBBER MILDEW

Goodyear Tire & Rubber Co., Inc.—How mildew, a destructive enemy of rubber conveyer belts, was conquered is told in a 26-page bulletin.

296 HYDRAULIC PUMPS AND MOTORS

Commercial Shearing & Stamping Co.—Performance characteristics of PD series single oil hydraulic pumps furnished in gear widths 1/2, 3/4, 1, 1 1/2, 2, 2 1/2, and 3 in. are recorded in charts and tables. Horsepower input and gallonage discharge are shown through a pressure range from 0 to 1500 psi and a speed range up to 3000 rpm. Also, performance characteristics of MD series single oil hydraulic motors furnished in gear sizes 1, 1 1/2, 2, 2 1/2, and 3 are given in charts and tables. Gallonage input and corresponding horsepower delivery are shown through a pressure range from 0 to 1400 psi over a speed range up to 1200 rpm.

297 ROLLER CONVEYORS

E. W. Buschman Co.—Catalog 60 provides information for selecting the roller conveyer best suited to your requirements. Roller design, side frames, roller curves, supports, etc., are covered.

298 AIR CONDITIONERS

Trane Co.—Data on Trane self-contained air conditioners is covered in Bulletin D-362. Includes mechanical data, unit selection, refrigeration capacities, condenser water requirements, water valve data, fan performance, electrical characteristics, etc.

299 BOILERS

Kewanee-Ross Corp.—Kewanee Steel Boilers, Lo and Hi Pressure Series. Welded and Riveted for mechanical or hand-firing and convertible. Steam radiation ratings 1380 to 42,500 sq ft commercial, 510 to 8000 sq ft residential sizes. Shown in 24-page General Catalog 80.

300 ELECTRONIC SCALE

Streeter-Amet Co.—Streeter-Amet, working with the Baldwin-Lima-Hamilton Corporation has created an electronic weight determination instrument. By use of electronic cells this new scale will record and print on ticket, tape, or even a ledger, remote from the scale, the exact weight. A brochure explains the simplicity of construction, the low maintenance, and the ease of installation of this new scale.

301 COLD FORMING

Parker Rust Proof Co.—The use of Bonderite as an aid in cold forming of steel, stainless steel, or aluminum is covered in a new bulletin. In addition a reprint entitled, "Application of Wear Resistant Phosphate Coatings to Ferrous Surfaces," is also available.

302 CENTRIFUGAL COMPRESSORS

American Blower Corp.—Bulletin 109 provides information on the functions, applications, ratings, and design features of single-stage centrifugal compressors.

303 BALL AND ROLLER BEARINGS

Gwilliam Co.—Catalog 28 lists information on standard bearings, bearings carried in stock, special bearings, and duplication of bearings. Typical sections of the various types are included.

304 COAL DISTRIBUTORS

Stock Equipment Co.—Conical nonsegregating coal distributors for delivering a uniform mixture of coarse and fine coal across the stoker hopper are pictured and described. Some applications are included.

305 BLOWERS

Lau Blower Co.—Catalog 608 gives dimensional data and performance characteristics of Series single inlet blowers.

306 SEPARATOR-FILTERS

Jas. A. Murphy & Co., Inc.—Data sheet describes new Triumph AA separator filter. Operation of unit is given.

307 ROTARY SOLENOIDS

G. H. Leland Inc.—Applications of Ledex rotary solenoids such as in automotive, trucking, materials-handling equipment, graphic arts, business machines, and aircraft are given. General design information is also included.

308 PLANT CONSTRUCTION

York Engineering & Construction Co.—Bulletin discusses construction and engineering project beginning at the conference table, plant layout, costs, contractors and subcontractors, and progress made. Some typical jobs are shown.

309 PRESSURE VESSELS

Scaife Co.—Pressure vessels for air, water, and gases, are illustrated and described. Data for both horizontal and vertical types are given.

310 SICROMATIC CHARTS

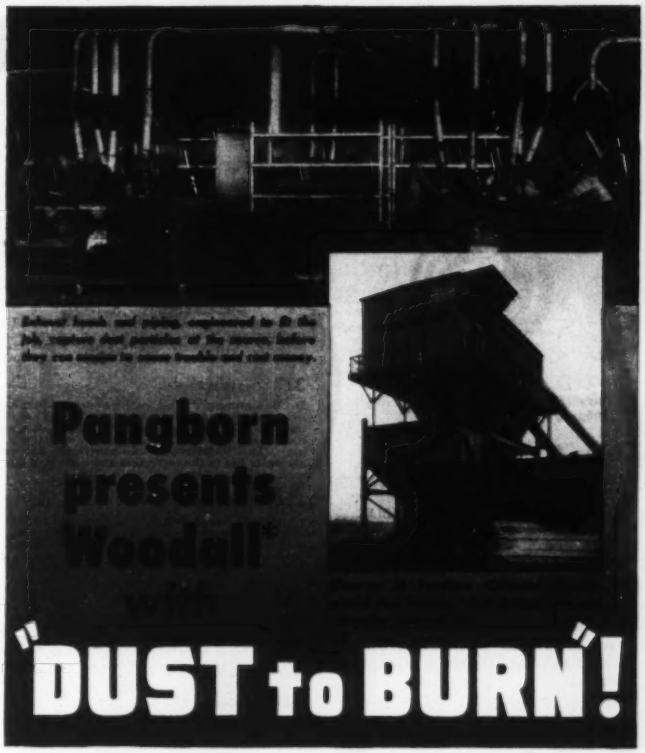
Marlo Coil Co.—For the first time in the history of air conditioning, coil selections can be made simply, accurately, and in a matter of seconds—from a single chart. This "Sicromatic" Chart and a special "Sicromatic" Rule used with the Chart are being offered to architects, designers, engineers and contractors.

311 HYDRAULIC CYLINDERS

Commercial Shearing & Stamping Co.—Catalog H-3 presents a complete standard line of double-acting, single-acting, telescopic oil hydraulic cylinders of the heavy-duty type, suitable for operating pressures up to 1500 psi "Commercial" standard heavy-duty cylinders. Complete details covering many different types of mountings, style of fittings, ratings, dimensions, and mounting data are fully covered.

312 AIR HANDLING, COMFORT CONDITIONERS, COOLING TOWERS

Bush Mfg. Co.—Catalogs and bulletins containing valuable engineering and selection data. Coil



How Woodall Industries, Inc., uses Pangborn equipment to save $14,000 per year!

Woodall Industries, Inc., Long Island, N. Y., produces Masonite panels in varying shapes and sizes for the automotive, railroad, television, and refrigeration industries, to name just a few. Shaping and drilling these panels produces Masonite dust—and plenty of it!

Without an effective system of dust control, Woodall workers would soon be knee-deep in dust. Thus, the Pangborn Dust Control System installed at Woodall would be essential at any cost. The beauty of the system, however, is that it *doesn't cost at all*—but actually pays its own way, with a nice profit to boot!

That's because this Pangborn Dust Control System not only maintains a dust-free plant, but also provides *all* the fuel for all heating and processing requirements, by conveying the Masonite dust from its source to a boiler furnace. Savings in oil alone have been figured at about $14,000 a year!

Add to this the savings in "housekeeping" costs, benefits in improved health and morale of employees—and you can see why Woodall is so enthusiastic about their Pangborn Dust Control System.

What are your Dust Problems? Find out what Pangborn can do to solve them. Write today for Bulletin 909A. Address: PANGBORN CORPORATION, 2200 Pangborn Blvd., Hagerstown, Md.

Look to Pangborn for the latest developments in Dust Control and Blast Cleaning equipment

Pangborn DUST CONTROL

STOPS THE DUST HOG from stealing profits

2500 P.S.I.
MERCOID
DA PRESSURE CONTROLS PROVIDE THE SENSITIVITY YOUR APPLICATION REQUIRES

Available in pressure ranges varying from 30" vacuum to 2,500 p.s.i.

- FULLY ADJUSTABLE AS TO RANGE AND SENSITIVITY
- BOURDON TUBE OPERATED
- VISIBLE CALIBRATED DIAL
- MERCOID SEALED MERCURY CONTACT

30 VAC.

CATALOG SENT UPON REQUEST

THE MERCOID CORPORATION
4201 BELMONT AVE., CHICAGO 41, ILLINOIS

industrial
OIL AND GAS BURNING EQUIPMENT

Mechanical Atomizing Oil Burners
Steam Atomizing Oil Burners
Low Air Pressure Oil Burners
Rotary Oil Burners
Industrial Gas Burners
Combination Gas and Oil Burners
Tandem Block Combustion Units
Fuel Oil Pump Sets
Refractory Burner and Muffle Blocks
Valves, Strainers, Furnace Windows

Detailed information gladly sent you upon request

NATIONAL AIROIL BURNER COMPANY, INC.

1239 E. Sedgley Ave., Philadelphia 34, Pa.
Southwestern Division: 2512 So. Blvd., Houston 6, Tex.

catalog No. 705. Air Handling Units catalog No. 710. Cooling Tower and Evaporative Condenser catalog No. 510. Commercial Refrigeration catalog No. 350. Comfort Conditioners No. 530. Baseboard Radiation No. 565. Convectors No. 545. Finned Radiation No. 525. Covers for finned radiation No. 720.

313 RESEARCH APPARATUS

Research Vacuum Supply Co.—Circular describes new and improved products such as 3-burner torches, gas-air mixers, fishtail burners for slow burning natural gas, improved blow torches, compound vacuum pumps, and recording counters for research work.

314 MANOMETERS

Trimount Instrument Co.—Bulletin on Red Line manometers illustrates well-type manometers, absolute pressure manometers, U-tube manometers, indicating flowmeters, orifice flanges, and plates.

315 GLUCOSATES

D. W. Haering & Co., Inc.—A new booklet announces a new way to buy glucosates. They will now sell their various glucosates which are a corrective for corrosion and scale in drums ready to use. The booklet tells the particular use each glucosate has in the correction and control of corrosion, scale, and algae.

316 ELEVATORS

Charles W. Lerch & Assoc.—"Elevator Dollars at Work" is a new booklet for all building owners, managers, and administrators—especially those who operate office buildings, hospitals, lofts, apartments, and hotels.

317 MECHANICAL SEALS

Crane Packing Co.—Bulletin shows clear sectionized drawings of type 9A shaft seal original equipment seals and type 9 shaft seal for replacement applications. Also typical applications discussed and illustrated, materials used, construction, and operation.

318 COOLING COILS

Mario Coil Co.—A cooling coil bulletin on the complete line of Mario cooling coils for direct expansion refrigerants, circulating water, and brine is offered. This bulletin gives design, construction, and dimensional data plus Psychometric Charts.

319 SPIRAL-WOUND GASKETS

Flexitallic Gasket Co.—General Catalog gives properties, applications, construction features and advantages of Flexitallic spiral-wound gaskets. Illustrates and describes pipe flange gaskets for raised face, smooth face, male and female, tongue and groove joints. Also boiler manhole and handhole gaskets. Complete size and dimension tables. Includes gasket engineering data sheet to simplify ordering.

320 PNEUMATIC TRANSPORT SYSTEM

Kennedy-Van Saun Mfg. & Eng. Corp.—Bulletin 52-F describes the Kennedy pneumatic transport system used to convey materials within plants and for unloading bulk railroad cars. Ideally suited for handling cement, pulverized coal, carbon black, pulverized chemicals, Fullers earth, dry paints, flour, barites, grains, salt, mineral filler, fireclay, soda ash, hydrated lime, quick lime.

321 V-BELT DRIVES

Goodyear Tire & Rubber Co., Inc.—Booklet contains simplified reference tables so that the shop mechanic, farmer, or home hobbyist who wishes to design his own drive can use Goodyear belts and standard pulleys.

322 HYDRAULIC TORQUE CONVERTERS

Twin Disc Clutch Co.—Bulletin 135-D describes three-stage hydraulic torque converters providing up to 6-to-1 torque multiplication for 40-1000-hp engines, in industrial machinery encountering wide variations in engine load . . . and in heavy-duty on-and-off-highway trucking involving up and down hauling. Some models offer in-built converter braking.

323 SHAPED WIRE

Page Steel & Wire Div., American Chain & Cable Co., Inc.—16-page catalog DH-1226 describes how to cut production costs by the use of Page shaped wire available in low-carbon, high-carbon, and stainless steels, specially processed to meet exacting requirements for temper and physical properties, in a wide range of commercial finishes.

Have you heard ? about

THE LUBRICANT OF MANY USES

Moly-sulfide
A LITTLE DOES A LOT

In the shop—
In the field

Moly-sulfide is a solid-film lubricant, highly successful in applications involving extreme pressures, high velocity, fretting, elevated temperatures and other difficult frictional conditions. We have compiled detailed records of 154 different applications of molybdenum sulfide to actual shop and field problems—some of which might be similar to your own.

Shopmen, engineers, lubrication specialists—write now for a copy of this new 40-page booklet.

Climax Molybdenum Company
500 Fifth Avenue
New York City 36 N.Y.

Please send me your Free Booklet
Name.....
Position.....
Company.....
Address.....
ME 11

MOLY

MS4-A

324 INSTRUMENT VALVES

Edward Valves, Inc.—Bulletin No. 491 providing information on the new drop-forged steel Edward instrument valves for meter, gage, instrument, and other small lines. These new valves have a rating of 6000 lb WOG at 100 F or 1500 lb sp at 1000 F. Bulletin contains dimensions, weights, prices, and operating data.

325 TEST BOILERS

Besler Corp.—Test boiler bulletin, illustrated with photographs, drawings, and diagrams describes Besler high-temperature, high-pressure boilers. Designed by test engineers, these boilers are sectional, an innovation offering maximum flexibility, utmost weight and space conservation, and high efficiency. Bulletin contains specifications on 14 models with a range of capacities heretofore impossible to attain.

326 DUST COLLECTORS

Prat-Daniel Corp.—A new 8-page booklet, 4P 201, discusses the problems of flyash collection. It deals with the problems of stoker-fired boilers, pulverized-fuel firing, and other problems that are looming in importance today due to the ever-increasing restrictions on air pollution. The catalog describes the design of the 4P Collector, designed to meet these new restrictions, and its variations.

327 COOLING TOWERS

Foster Wheeler Corp.—A new illustrated, 36-page catalog on cooling towers contains details of construction, charts, suggestions on recirculation, and surroundings. It also includes "Inquiry Data Sheet" for planning your requirements.

328 SPEED REDUCERS

Dodge Mfg. Corp.—A new bulletin, A-614-A, covers the new size No. 7 torque-arm speed reducer which increased the capacity range to 43 hp. Maximum capacity of the previous largest size was 37. This new line of shaft-mounted reducers covers a speed range of 12 to 330 rpm. A new and quicker method of selection is included. In addition to perspective illustrations of the reducer and overload release, the new bulletin includes cross-section views and engineering diagrams showing proper positioning for installation.

329 INSULATING MATERIALS

Baldwin-Hill Co.—A new 20-page illustrated catalog describes insulating materials which cover the complete temperature range from −150 F to 1800 F. Insulating cement, block, blanket, felt, and pipe covering are a few of the products shown in the catalog. Complete with thermal-conductivity graphs and heat loss charts, this catalog also shows list prices subject to trade discounts. Brief application descriptions together with typical uses, sizes, packaging, and densities are also a part of the catalog.

330 UNIFLEX HOSE

Titeflex, Inc.—A special seamless bronze tube formed into a uniform helically corrugated, flexible hose which resists vibration and corrosion. This hose is leakproof and can be used under high pressure conditions and for temperatures up to 450 F. It is made to specification in sizes ranging from $\frac{1}{4}$ to 6 in. ID.

331 COMPRESSORS

Clark Bros. Co.—Catalog describes model HMA Gas-Engine-Driven Compressors of 2, 4, 6, and 8 cylinders, having brake horsepower of 80 to 330. Available as a "factory packaged" compressor station. Can be installed anywhere.

332 PRESSURE-SEAL VALVES

Edward Valves, Inc.—A new 16-page catalog describes pressure-seal stop, check, and nonreturn valves. Separate spreads in the booklet give complete descriptions, design characteristics and dimensional details on stop, check, and nonreturn valves. Each type is furnished in sizes from $2\frac{1}{2}$ to 14 in., and in 600, 900, 1500, and 2500 lb pressure classes. Tables and charts enabling readers to easily calculate the pressure drop in any Edward stop, check, or nonreturn valve are provided to aid in valve selection. Complete Materials Specifications, including detailed chemical analyses as well as physical characteristics are given.

333 MECHANICAL SPRINGS

Associated Spring Corp.—"The Mainspring," the house organ of its ten Divisions is offered. It contains articles of scientific and practical interest prepared for engineers, designers, and users of mechanical springs. Published bimonthly.

Smooth, Quiet Operation Wins Customer Acceptance

for BLACKSTONE CORPORATION

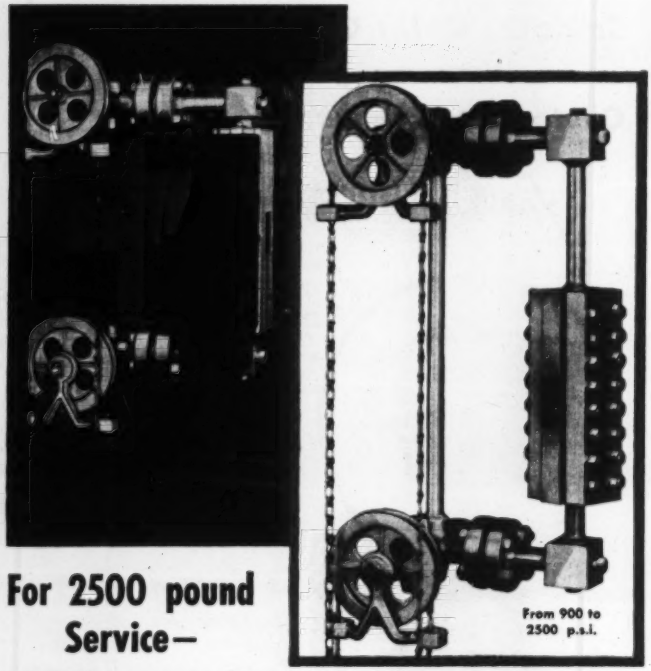
LORD Bonded-Rubber Mountings used in basic design help to increase sales for leading appliance manufacturers. Inherent Vibration and Shock are actually "designed out" of the appliance, resulting in smooth operation and longer service life. For instance, the famous Blackstone Automatic Washer does its work quietly and efficiently with the "spin dry" basket mounted on the Lord bonded-rubber flexible mounting. This Lord bonded-rubber flexible mounting compensates for unbalanced loading of the "spin dryer" during the clothes-drying cycle. This is another of many examples in which Lord engineering experience and precision manufacturing technique combine to advantage in basic design to speed up and increase end product sales in highly competitive markets. Consider increasing consumer preference for your product by using Lord vibration and shock control mountings.

20th National Exposition of
Power and Mechanical Engineering
Grand Central Palace, N. Y., Booth No. 558
December 1–6, 1952

BURBANK, CALIFORNIA	DALLAS, TEXAS	PHILADELPHIA 7, PENNSYLVANIA	DAYTON 2, OHIO
233 South Third Street	1613 Tower Petroleum Building	725 Widener Building	238 Lafayette Street
DETROIT 2, MICHIGAN	**NEW YORK 16, NEW YORK**	**CHICAGO 11, ILLINOIS**	**ERIE, PENNSYLVANIA**
7310 Woodward Ave.	280 Madison Avenue	520 N. Michigan Ave.	1635 West 12th Street

LORD MANUFACTURING COMPANY • ERIE, PA.

LORD BONDED RUBBER — *Headquarters for* **VIBRATION CONTROL**



For 2500 pound Service—

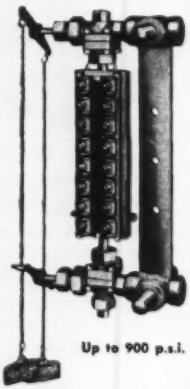
Reliance Super-Duty Gages

Rugged all-welded direct-to-drum assemblies

Various combinations of Reliance Gage Valves, Gage Inserts and Illumination have been supplied to power plants *since 1940* when Code changes called for two water gages on boilers operating over 400 p.s.i. Assemblies for higher pressures feature single, double or triple window inserts welded to flanges for valve connection in "L" end construction. Units for pressures to 900 p.s.i. can be made in tie-bar construction.

Reliance Micasight insert is recommended for higher pressures as by far the safest type known. Windows of selected mica are clamped securely under slotted cover plates — have many times the life of glass. Mica-protected Flat Glass inserts are available for lower pressures, recommended only to 1500 p.s.i. Efficient illumination, an extra, can be supplied for all types of gage assemblies.

Send specifications — pressure, visibility length, etc. — for recommendations and price.



The Reliance Gauge Column Co.
5902 CARNEGIE AVENUE • CLEVELAND 3, OHIO

The name that introduced safety water columns....in 1884

Reliance®
BOILER SAFETY DEVICES

334 SURFACE ROUGHNESS

Micrometrical Mfg. Co.—Bulletin L21 entitled, "How to Specify Surface Roughness—and Why," explains the meaning of "surface roughness" as applied to machined and finished surfaces; describes practical advantages of roughness specification; tells how to establish roughness specifications for parts in production, and for parts of new design; shows how to specify microinch roughness on working drawings; and briefly discusses shop measurement of surface roughness.

335 LOCKNUTS

Standard Pressed Steel Co.—Thin locknuts, one-third lower in height, which meet or exceed in many instances Army-Navy tensile requirements for regular-height locknuts are described in a new 26-page catalog. Sizes, fits, part numbers, dimensions, tensile values, materials, packing quantities, and weights are listed in the catalog for all Flexlocs in both thin and regular design and for aircraft and commercial use. The book is well illustrated.

336 GAS WATER HEATERS

Thermek Engineering Corp.—New bulletin describes and illustrates 5 models of these instantaneous water heaters using Thermek spined tubes. AGA-approved and ASME models, direct or indirect-fired. Sizes from 125,000 to 350,000 Btu. For radiant heating, convector and indirect warm air systems and cast-iron radiation; special models for swimming-pool heating. Bulletin gives specifications and installation data.

337 HOT DIP GALVANIZING

American Hot Dip Galvanizers Assoc. Inc.—Booklet discusses some of the galvanizing problems which are ever present, and which, if pointed out, will help in the estimating, design, and manufacture of materials to be galvanized.

338 TITEFLEX HOSE

Titeflex, Inc.—A convoluted metal tube which is designed so that any flexing which takes place is well within the natural limits of the metal. It will withstand pressure, temperature, vacuum, vibration destructive action of various liquids and gases.

339 PRESSURE GAGES

Helicoid Gage Div., American Chain & Cable Co.—New 16-page Helicoid gage catalog. The Helicoid gage is the only pressure gage with the Helicoid movement. It is guaranteed accurate to within $\frac{1}{2}$ of 1 per cent of the total dial graduation over the upper 95 per cent of the 270-deg dial arc. This means that on a 100-lb dial for example, accuracy is guaranteed to within $\frac{1}{2}$ lb over the entire scale except from 0 to 5 lb. Cutaway photographs and line drawings show the complete line of Helicoid gages.

340 BAR STOCK VALVES

R-P&C Valve Div., American Chain & Cable Co., Inc.—A 16-page booklet DH-766A, describes the R-P&C line of bar stock valves. Fully illustrated, it carries dimensions and complete material specifications—including tests, working pressures, and list prices—as well as the proper location for installing R-P&C bar stock valves.

341 SPUN END PROCESS

Wolverine Tube Div., Calumet & Hecla Cons. Copper Co.—Brochure describes the distinctive Spun End Process. In 28 pages it tells a concise story of a revolutionary metal-forming process that is highly efficient and relatively inexpensive. A quick comprehension of the process is gained through the many photographs, diagrams, and descriptions that make comparisons between old and new methods.

342 HEAT TRANSFER SYSTEMS

Hynes Electric Heating Div., Rodman H. Martin Co.—8-page bulletin No. 102 with illustrations, engineering data, dimensions, and descriptions of electric high velocity fluid heat-transfer systems at temperatures up to 650 F. Included are design features for piping, valves, pumps, controls and related auxiliaries, as well as operating instructions.

343 COMPRESSOR VALVES, PLATES, DISKS

J. H. H. Voss Co., Inc.—Literature describes Voss valves and Voss plates and disks which are applicable to any make, size, and type of air, ammonia, or gas compressors, including all the different refrigerating media; air, hydrogen, oxygen, gas, and corrosive media in vacuum-pump application. Available to manufacturers of new machinery as well as to users for replacements. Voss valves and valve plates are designed for each individual job and made on special machinery from the alloy or stainless steel best suited to the conditions under which they are to operate.

344 OIL SEALS

National Motor Bearing Co.—Catalog No. 102A lists standard types and sizes of National oil seals. Listings are presented two ways: (1) by shaft diameter and (2) by seal or design number. Listings indicate proper housing bore and thickness of the oil seals. This catalog is divided into three sections: (1) engineering data, (2) listings of leather series, and (3) list of Syntech series (synthetic rubber).

345 GEAR AND GEAR UNIT APPLICATIONS

Farrel-Birmingham Co.—First two issues of Equipment News deals specifically with the above. (Nos. 39-G-523 and 40-G-524.) These 4-page bulletins describe and illustrate Farrel gears and gear units in mine hoist, oil pipe line, paper mill, and marine service.

346 COMPRESSOR AND VACUUM PUMPS

Fuller Co.—Bulletin C-5A illustrates and describes by photographs and drawings, the construction of Fuller rotary compressors and vacuum pumps; tables of sizes and capacities; illustrations of installations in various industries.

347 COPPER AND COPPER ALLOYS

American Brass Co.—A revised edition of "Copper and Copper Alloy Specification Index" provides up-to-date specifications of the various national engineering societies and government agencies, including "Military" (Munitions Board, Department of Defense) specs. The 28-page publication is divided into two sections. The first lists the most generally used copper alloys together with the applicable specifications of nine different agencies. The second lists specifications in numerical order with a brief description of the material as to alloy, grade, type, temper, anneal, etc.

348 THREE-WAY VALVES

Andale Co.—Bulletin 461-C-(R1) lists following applications: Where a stream *from* a single line is to be directed to either of two parallel lines or to both for example, to connect two safety valves or safety disks in parallel on a single vessel. Working pressure ratings and dimensions, sizes: 1 to 6 in. cast steel for pressures 300 to 900 psig and sizes 1 to 12 in. cast iron for 125 psig; cast steel for 150 psig.

349 GEARS, SPEED REDUCERS

Lufkin Foundry & Machine Co.—A 48-page catalog G-1 covers complete line of horizontal, parallel shaft herringbone gear speed reducers of single and double-reduction types, and also speed increasers with ratios up to 12:1. Complete information on method of selection, service factors, horsepower ratings, together with dimensions and examples.

350 PUMPS

Economy Pumps, Inc.—A single sheet, illustrates many types of pumps manufactured. It offers a guide to those who are interested in requesting additional catalog material and engineering data.

351 THREAD INSERTS

Heli-Coil Corp.—Design and engineering data on the complete line of Heli-Coil screw thread inserts—for the protection and repair of tapped threads in all materials—is contained in a 24-page, two-color catalog, No. 652. Covered are drilling and tapping recommendations, installation procedures, and standard fits available.

352 OVERLOAD CUTOUTS

John Waldron Corp.—A 12-page catalog No. 51 contains sizes and engineering information on an automatic overload cutout device which instantly shuts off motor when an overload occurs.

353 LUBRICANTS, QUENCHING OILS, ETC.

E. F. Houghton & Co.—Product index of Houghton processing and maintenance products gives brief description with product names covering lubricants, coolants, quenching oils, heat-treating products, and leather belting and packing.

354 BLAST CLEANING AND DUST CONTROL

Pangborn Corp.—The latest developments in blast cleaning or dust control in Bulletin 1200 Pangborn's "Condensed Catalog." This illustrated bulletin tells the full story of air and airless blast cleaning, hydro-sand blast, hydro-finish, wet sand blast, accessories, and dust control.

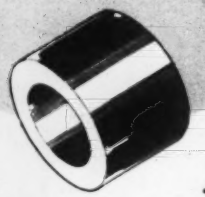
355 PNEUMATIC POSITIONERS

Republic Flow Meters Co.—A 4-page bulletin is available on Pneumatic Positioning Operator which is designed for high-speed positioning and regulation. Fully described and illustrated are the high-

Why you can place full confidence in BOILER FEED PUMPS by Pacific
IT'S A MATTER OF RECORD
That the availability for service of your boiler feed pump and the cost of maintaining it in top condition is determined by design . . . workmanship and materials of construction.
IT'S A MATTER OF RECORD
Pacific's designs provide the balanced proportions that insure mechanical strength . . . the simplicity of form that insures hydraulic efficiency . . . material efficiency . . . easy maintenance.
IT'S A MATTER OF RECORD
Pacific's precision workmanship provides . . . metal-to-metal sealing of internal joints to prevent water jetting from a high to a low pressure area . . . truly concentric shaft sleeves . . . close sliding fits, making it unnecessary to "shrink" impellers on the pump shaft.
IT'S A MATTER OF RECORD
Pacific Boiler Feed Pumps are fabricated from materials carefully selected for specific functions . . . steel forgings for structural strength and stability . . . alloy steels for hardness . . . resistence to wear and to corrosion-erosion.
IT'S A MATTER OF RECORD
Pacific Multi-Stage Boiler Feed Pumps are built for capacities to 2700 G.P.M. . . . Discharge Pressures to 3000 psig . . . speeds to 5000 R.P.M. . . . Bulletin 109 for details.
Pacific Single Stage TURBOPUMPS are built for capacities to 1000 G.P.M. . . . Discharge Pressures to 1800 psig . . . Speeds to 10,000 R.P.M. . . . Bulletin 118 for details
PACIFIC Precision Built PUMPS
Pacific Pumps inc.
HUNTINGTON PARK, CALIFORNIA
Export Office: Chanin Bldg., 122 E. 42nd St., New York
Offices in All Principal Cities

GRAPHALLOY
TRADE MARK REG. U. S. PAT. OFF.

OIL-FREE
SELF-LUBRICATING
BUSHINGS



"WORK WHERE OTHERS WON'T"

Widely Used Where Ordinary Oil Lubrication Is Impractical or Impossible.

EXCELLENT DURABILITY • CONSTANT CO-EFFICIENT OF FRICTION • APPLICABLE OVER A WIDE TEMPERATURE RANGE — EVEN WHERE OIL SOLIDIFIES OR CARBONIZES • **OPERATE DRY, OR AT HIGH SPEEDS SUBMERGED IN WATER, GASOLINE AND OTHER LIQUIDS • EXCELLENT FOR CURRENT-CARRYING BEARINGS**

GRAPHALLOY materials are also in wide use for oil-free, self-lubricating piston rings, seal rings, thrust washers, friction discs, pump vanes etc.

OTHER GRAPHALLOY PRODUCTS

BRUSHES

CONTACTS

For applications requiring low electrical noise, low and constant contact drop, high current density and minimum wear. Used for SELSYNS, DYNAMOTORS, SYNCHROS, ROTATING STRAIN GAGE pick-ups and many other applications. Brush Holders and Coin Silver Slip Rings also available.

Write for data sheets. Outline your problem and let us help solve it.

GRAPHITE METALLIZING CORPORATION

1058 NEPPERHAN AVENUE • YONKERS N. Y.

capacity pilot valve and actuating mechanism that enables the operator to overcome starting friction and inertia. Return motion mechanism which prevents overtravel is also explained and illustrated. Bulletin contains clearance dimensions for mounting the Positioning Operator at almost any angle.

356 UNIT WORK BENCHES

Standard Pressed Steel Co.—Bulletin 841 describes Hallowell Unit Benches, featuring large storage space. Units comprise two pedestals, two bases, one top, serve as single work stations or continuous benching. Pedestals are 4-drawer or cabinet-type. Two lengths, two widths of steel, Presdwood-covered steel, or laminated wood tops; two heights of bases. Accessories available.

357 ELECTRIC MOTORS

Sterling Electric Motors, Inc.—A 20-page catalog contains complete descriptive information on variable speed drives, geared motors and constant normal speed motors in dripproof, splashproof, totally enclosed and pipe ventilated designs.

358 PLATE FABRICATION AND HEAT EXCHANGERS

Downingtown Iron Works, Inc., Div. of Pressed Steel Tank Co.—A new catalog condenses the more pertinent and useful data compiled from Downingtown's last three catalogs. Featured is a detailed heat-exchanger section, including: Performance and Mechanical Design, Tube Sheet Layout with Tables, Standard Construction, and illustrated examples. Includes information on Facilities; Manufacturing Equipment; Welding Procedure Qualifications; and Typical Examples of Plate Fabrication. Also highlighted is a partial analysis of the ASME Code for Unfired Pressure Vessels.

359 PUMPS

Aldrich Pump Co.—Catalog on reciprocating pumps, 10 to 2400 hp, includes data on direct flow pumps, 3, 5, 6-in-stroke series, 10 to 900 hp (3, 5, 7, and 9-plunger units); on Aldrich-Groff controllable capacity "Powr-Savr" pumps (5 to 125 hp); and on inverted vertical pumps, up to 2400 hp, 7 in. through 8½-in-stroke sizes.

360 FLEXIBLE METAL HOSE

Atlantic Metal Hose Co., Inc.—An 8-page catalog (No. 500), provides the latest data on Atlantic flexible metal hose. Interlocking and seamless types are covered. Complete applications are given. Of value are a Navy test table for bronze and steel hose; data on bending diameters and hydrostatic bursting pressure; and a series of installation diagrams.

361 FIBERGLAS STRUCTURAL PANELS

Resolite Corp.—A new 12-page catalog describes Resolite translucent structural panels of Fiberglas-reinforced plastic, manufactured in 8 standard colors and tints. In addition to specifications, loading, and light transmission values, and other physical characteristics of this building material, the catalog pictures suggested structural applications with detailed drawings for home or office partitions, patio covering, building facing, industrial skylighting, toilet and shower stalls, and other practical uses.

362 PLANT LAYOUT

"Visual" Planning Equipment Co., Inc.—A newly compiled report gives an analysis of the best types of equipment to be used for plant layout purposes.

363 PUMPS

Oberdorfer Foundries, Inc., Industrial Pump Div.—Catalog contains illustrations, capacity tables, dimensions, and prices of six lines of small corrosion-resistant pumps widely used in industry. Series I—Bronze rotary gear type for continuous, heavy-duty positive displacement service. Series II—Close-coupled bronze rotary gear type for use where space is limited. Series F—Bronze rotary gear type for high volume low speed applications. Series IV—Bronze, rubber impeller type for low pressure liquid transfer. Series 55—Bronze rotary gear type for intermittent positive displacement service. Series G—Bronze, open-impeller centrifugal type for limited volume liquid transfer.

364 SOCKET SCREWS, PLUGS, DOWEL PINS

Standard Pressed Steel Co.—Unbrako "Standards" bulletin displays in two colors all the standard sizes available in the entire Unbrako line, including socket head cap screws, self-locking socket set screws (with knurled cup point), button head socket cap screws, shoulder screws, flat head socket cap screws. Dryseal-thread pressure plugs, square head set screws, precision-ground dowel pins, and hexagon socket screw keys.

ASME MEMBERS

Be sure to request your

1953 ASME MECHANICAL CATALOG AND DIRECTORY

promptly.

Free to Members

Reserve your copy of the next Volume by returning Request Card mailed to you about July 1. Please do this now so that you won't be disappointed in not getting a copy. If you did not receive a card, send in request on your own letterhead.

ASME CATALOG

published by

American Society of Mechanical Engineers

29 West Thirty-Ninth Street

New York 18, N. Y.

365 THERMISTORS

Carboloy Dept., General Electric Co.—The latest Thermistor Catalog gives detailed information on Carboloy Thermistors under the following classifications: General Information Section which lists a definition of a thermistor, basic characteristics, operating and physical characteristics, and typical thermistor applications; Specific Data Section containing temperature-resistance ratio characteristics; a Carboloy Specification Section listing specifications for Standard Carboloy Disk Type Thermistors, Standard Carboloy Washer Type Thermistors and Standard Carboloy Rod Type Thermistors; and, finally, suggested applications for thermistors in various industries.

366 FLOWMETERS

Republic Flow Meters Co.—A pneumatic flowmeter for measuring widely fluctuating flows, dirty fluids, and other difficult fluids is described in a new bulletin. The flowmeter can be adapted to operate at static pressures as high as 2000 psi and differential pressure 0.6 to 704 in. water. Reading instruments may be several thousand feet from the point of measurement. Hook-ups, meter components, and applications are discussed and illustrated.

367 MATERIALS HANDLING

Clark Equipment Co.—The story of its engineering, production, technical counsel to customers and prospects, and of its world-wide service setup is told by the Industrial Truck Division in words and pictures in the new edition of its magazine, *Material Handling News*. This edition provides a succinct review of its fork-lift trucks, powered hand trucks, and industrial towing tractors features, and then emphasizes its service to prospects and customers in planning materials-handling systems, in training its own and customers' service and maintenance personnel, and its world-wide service facilities.

368 WELDING

Metalweld Inc.—A 4-page folder covers welding repairs and fabrication. Includes different processes, repairs in all types of industries, machining and finishing, etc.

369 LEVER SEALD VALVES

Homestead Valve Mfg. Co.—Reference book 39-3 offers complete information on Lever Seald Valves made of brass, semisteel, cast steel, and other metals for specific service conditions. Specifications for these valves, which feature "stickproof" operation, are given in charts, with photos and line drawings illustrating each type valve. Also included in this 16-page catalog are on-the-job photos of Lever Seald Valves, illustrating their many uses.

370 SELF-CONTAINED BOILERS

Cleaver-Brooks Co.—New boiler catalog No. AD-100 completely describes the self-contained LR boilers for heating and processing. Lists features, shows typical applications, covers design, construction, efficiency, and contains charts on capacities and dimensions. The back cover is devoted to engineering service and a complete list of sales representatives handling and servicing Cleaver-Brooks self-contained boilers.

371 PISTON RINGS

Koppers Co., Inc.—Piston Ring Dept.—16-page folder describes Koppers "American Hammered" piston rings for industrial use. Individual ring types shown with specifications for use in combustion engines, hydraulic systems, compressors, etc.

372 VENTILATING FANS

Propellair Div. of Robbins & Meyers, Inc.—Latest catalog, Form 3238, describes uses of various types of Propellair ventilating fans such as tubeaxial, vaneaxial, Sky-Blast, belt-driven, pulley-driven, etc. Typical modern industrial applications of Propellair equipment are pictured.

373 METERS

Builders-Providence, Inc.—Latest catalog describes the improved Model SMKS Shuntflo meter for steam, air, or gas. In addition to the new streamlined appearance of this time-proved meter, several changes have been made in the mechanism for greater strength and easier replacement of parts.

374 MICROMATIC MICROHONING

Micromatic Hone Corp.—Cross-Hatch a bimonthly publication describing and illustrating the fundamentals of the Microhoning process. Each issue graphically presents the full story of one type of equipment or application. Photographs of equipment in actual operation are given with the complete story of the accomplishments. Back issues are available.

Product of:
Westinghouse Corp.
Mansfield, Ohio

with CHACE BIMETAL

Westinghouse relieves housewives from heavy washday lifting and weather worry with its Automatic Clothes Dryer Model D-3. The control system consisting of three thermostats is actuated by Chace Thermostatic Bimetal. Most vital, the cycling thermostat is calibrated to give the proper temperature to the air striking the wet clothes in the dryer. It controls the 1400 watt heating element which maintains a given temperature range regulating the drying time of the wash load.

When the dryer is turned on, the thermostat contacts "A" are in a closed position which energize the heaters. A high line voltage will cause overheating of the air and move the bimetal element "B" against the contact spring "C", opening the contacts of the heater circuit. The air temperature then decreases and if it falls below a minimum value, the bimetal element "B" reverses its movement away from the spring "C", closing the heater circuit "A". Thus, the temperature of the air striking the clothes is the same, regardless of line voltage.

The reliability of these thermostats is dependent upon Chace's precision manufacturing methods. Chace Thermostatic Bimetal is furnished in 29 types in coils, strips, random long lengths and welded or brazed sub-assemblies. Before proceeding with the design of your new actuating device, consult our Application Engineers, recognized authorities on temperature responsive devices—or write today for our new 32-page booklet, "Successful Applications of Chace Thermostatic Bimetal," containing condensed engineering data.

W. M. CHACE CO.
Thermostatic Bimetal
1619 BEARD AVE., DETROIT 9, MICH.

A Selected List of ASME BOOKS for Engineers and Libraries

SHOCK AND VIBRATION INSTRUMENTATION 1952 $2.00

A collection of seven papers dealing with applications of shock and vibration instruments for various services, and problems encountered in their design.

DESIGN DATA 2 VOLUMES 1944

CONTENTS OF VOLUME 1, STRENGTH OF MATERIALS $1.50

Stress and Deflection of Circular Plates. Stress Deflection of Rectangular Plates. Circular Beams Loaded and Normal to the Plane of Curvature. Thermal Stress. Torsional Stresses in Shafts having Grooves or Fillets. Factors of Stress Concentration Photoelastically Determined. Stresses in Pressure Vessels. Press- and Shrink-Fitted Assemblies. Working Stresses. Formulas for Calculating: (1) Load, Deflection, and Stress in Helical Compression and Tension Springs, and (2) for the Design of Piping.

CONTENTS OF VOLUME 2, MECHANICS $1.50

Vibration Problems. Balancing of Rotating Apparatus. Harmonic Coefficients of Engine Torque Curves. Shortening the Time of Applying Theoretical Formulas to Solving the Common Design Problems of Uniform, Flat, and Circular Plates. Result of Calculation for the Deflections and Moments in Rectangular Plates with Hydrostatic Loading. Circular Beams Loaded Normal to the Plane of Curvature. Formulas for Calculating Loads, Rotation, and Deflections of Quarter Bends and Tangents of Pipes.

MODERN REHEAT TURBINES AND BOILERS 1952 $2.00

Aspects of reheating treated include design, progress and service experience; advantages and disadvantages of the reheat cycle; normal start-up, quick start-up, normal operation, and shutdown of modern reheat boilers under normal or emergency conditions; and design factors relating to their performance and operation; special features of operation of several new reheat boilers; conversion to centralize control of auxiliaries; reheat steam temperature control; turbine overspeed control as affected by reheat; and reheat development during the past twenty-five years.

GAS TURBINE PLANT HEAT EXCHANGERS 1951 $3.00

Provides much needed basic heat transfer and flow friction design data for compact heat exchanger surfaces. Included are descriptions of the 34 surfaces considered, test results, dimensions and a scale diagram for each surface, examples of heat exchange performance calculations, etc.

PRINCIPLES OF OPTIMALIZING CONTROL SYSTEMS AND AN APPLICATION TO THE INTERNAL COMBUSTION ENGINE 1951 $2.00

CONTENTS: General Principles of Operating Systems. Methods of Realizing Optimum Performance. General Principles of Optimalizing Control Systems. Sensitivity Signal Input Optimalizing Controllers. Continuous Test Signal Optimalizing Controllers. Output Sampling Optimalizing Controllers. Peak Holding Optimalizing Controllers. Recovery Time of Optimalizing Control Systems. Output Hunting in Optimalizing Controllers with Operating Component Response Delays. Output Hunting Loss. An Experimental Peak Holding Optimalizing Controller for a Reciprocating Internal Combustion Engine. Summary of the Test of the Experimental Controller.

RECOMMENDED PRACTICES FOR CLEANING TURBINE LUBRICATING SYSTEMS 1952 $1.00

Makes available procedures with respect to the preparation of new turbine lubricating systems, the cleaning of lubricating systems after service, and the preparation of turbine oils. Recommendations are based on information furnished by turbine builders, operators, oil suppliers, and consulting engineers.

SMALL PLANT MANAGEMENT 1950 $6.00

This practical Guide to know-how management is based on a study of small plant activities in different industries throughout the country. It thoroughly treats every significant management topic from the principles of scientific management to financing; banking; accounting; legal requirements; taxes; labor relations; unions; plant planning; organizing; operating and controlling; and obtaining best facilities, materials, productivity, and sales.

20% Discount to ASME Members

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
29 West 39th St., New York 18, N. Y.

375 OIL MIST PRECIPITATOR

Trion, Inc.—Catalog E-50 describes in full the purpose, principle of operation, construction features, and application of new oil mist precipitator specifically designed to meet the requirements of industry for the elimination of coolant oil mist and smoke emanating from high-speed cutting, grinding, and machining operations. This oil mist and smoke presents a health and safety hazard to plant workers unless properly collected.

376 UNIVALVES

Edward Valves, Inc.—A new 8-page catalog describes Univalve integral seat all-purpose forged-steel valves rated for 1500 to 2500 lb. Complete material specifications, including detailed chemical analyses as well as physical characteristics, are given. Graphic illustrations show outstanding Univalve features such as impactor handwheel, streamlined straight-through flow passages, positive backseat, and leakproof bonnet. A special picture section illustrates step-by-step simple disassembly procedures.

377 SPREADER STOKER SELECTION

American Engineering Co.—14-page form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered in the selection. It pictures and describes in detail the principle operating parts of manufacturer's stokers emphasizing their advantages. Includes engineering drawings and photos of several typical installations.

378 FLEXIBLE COUPLINGS

Ajax Flexible Coupling Co.—Bulletins available on the new Ajax Dihedral Coupling designed to handle misalignment. Misalignment capacity and performance of the new Ajax Dihedral Couplings are based on a tooth shape which provides for maximum misalignment with clearance or backlash held to oil film requirements.

379 AIR CONDITIONING

Sturtevant Div., Westinghouse Electric Corp.—Equipment for air conditioning, air handling, and air cleaning is described. Features specifications, and descriptive material on air conditioners, unit heaters, home electronic air cleaners, hermetically-sealed compressors, and condensers and water coolers are included.

380 ROLLED AND WELDED STEEL PRODUCTS

Cleveland Welding Co.—Bulletin No. W-500 describes Cleve-Weld circular, rolled, and welded steel products. Various types of circular weldments and accompanying advisory service are illustrated.

381 DOWTHERM VAPORIZERS

Union Iron Works—Union offers a helpful bulletin for users, or potential users, of Dowtherm "A" or "E". Tables of chemical and physical characteristics are included, as well as pertinent dimensions of several sizes of Dowtherm vaporizers. Union engineering, manufacturing, and installations service covers a wide range of sizes and types of Dowtherm systems.

382 BIN-FLO AERATOR UNIT

Bin-Dicator Co.—4-page bulletin BF-1 with enclosures gives complete description and illustrations of unit; application data, typical layouts, air pressure consumption supply and piping data, specifications, prices, and installation instructions; and list of present users. Simple low-cost device provides uniform and continuous flow of dry, finely ground materials from bins, hoppers, and chutes by introducing small volumes of low-pressure air.

383 PRESSURE GROUTING INFORMATION

Gardner-Denver Co.—Bulletin P-60 contains pressure grouting information, construction details of the Duplex high-pressure steam pumps for grouting service, stationary air compressors, and hand held drills. Supplemented with charts, diagrams, and illustrations, and other informative matter.

384 REVERSING VALVE STEAM ENGINES

Soulé Steam Feed Works—"Steam Feed" booklet contains full description of twin-cylinder steam engine rated 16 hp with 100 lb steam at 300 rpm. Speed and direction of operation obtained by one throttle valve. Originally sawmill carriage feed engine, suitable for any use requiring these characteristics. Many in use operated by air.

385 ROLLING DOORS

Kinnear Mfg. Co.—New 32-page fully illustrated bulletin No. 76 on a galvanized steel sectional over-

head-type door that combines durability with operating convenience and facilities for glass light sections in a door for all types of commercial and industrial service openings is offered. It gives details, clearance requirements, and available accessories.

386 STEAM GENERATORS

Preferred Utilities Mfg. Corp.—Bulletin 2000 contains a description of the principal design features of the four-pass Preferred Unit Steam Generator. A complete list of standard and accessory equipment plus a table of dimensions is also included.

387 HYDRAULIC PUMPS AND MOTORS

Gerotor May Corp.—New catalog folder G-110 describes the operation of the patented Gerotor principle in hydraulic pumps and motors. Gives essential selection data, pressures, speeds, rotation, oil and mounting information for 11 sizes of pumps and 6 sizes of motors in the Gerotor line. Maximum pressures are 1200 psi continuous, 1500 intermittent.

388 GRAPHALLOY PRODUCTS

Graphite Metallizing Corp.—Catalog 112 describes metal-impregnated self-lubricating bushings which contain no oil and require no oil. They have been manufactured and developed ever since being patented in 1913. Grades suitable for a wide range of loads, speeds, and temperatures are suggested. Graphalloy bushings are used successfully in high, room, or extremely low temperatures; in applications where high loads or high speeds do not permit conventional lubrication; and in submerged installations.

389 OIL BURNERS

Hauck Mfg. Co.—How guesswork and product spoilage can be minimized on industrial heat processing furnaces, is explained in 24-page catalog No. 410 describing the Hauck proportioning oil burner. Cutaway views illustrate the single lever control design for regulating both oil and air simultaneously. Fuel-air ratio is automatically maintained at all firing rates.

390 HIGH-PRESSURE COMPRESSORS

Norwalk Co., Inc.—Catalog No. 40 describes high-pressure compressors of all types—from one to six stages up to 25,000 lb pressure—for all different types of gases. Also described are special compressors built to customer's specifications. A feature is a check list to save the customer's time when inquiring or ordering compressors.

391 CHAIN-GRATE STOKERS

Illinois Stoker Co.—Catalog describes a chain-grate stoker with medium-height side frames for installation under boilers up to about 500 hp. The side frames are of ample height to admit sufficient air required for combustion and this construction saves at least one foot in the setting height of the boiler. The stoker is used for either free-burning bituminous coal or anthracite.

392 CONNECTIVE COUPLINGS

Hansen Mfg. Co.—New catalog is composed of various loose-leaf bulletins, each of which incorporates complete information, engineering data, dimensions, etc., pertaining to any particular type of Hansen coupling, such as straight-through, one-way shut-off, or two way shut-off—or special service couplings for oxygen, acetylene, gasoline, steam, or other applications.

393 MAGNETIC SEPARATORS

Eriez Mfg. Co.—Various applications of Eriez nonelectric permanent magnetic separators are described in the following bulletins: No. 15, nonelectric permanent magnetic separators for tramp iron removal; No. 553-A, the ferrous filter; No. 554, micromagnetic separator; No. 702, magnetic hump nonelectric permanently magnetized; No. 501-A, nonelectric permanent magnetic pulley.

394 METAL-WORKING PRESSES

American Steel Foundries. Elmes Engrg. Div.—6-page Bulletin 1011 illustrates and describes new Elmes pipeless metal-work ng presses. Main hydraulic circuit has no piping. All high-pressure fluid is conducted through short, direct passages drilled in structural parts. Result is low-cost maintenance with down time practically eliminated.

395 REFRACTORIES

Harbison-Walker Refractories Co.—A new bulletin on the smooth working, super duty Silica cement for use in laying refractory silica brick. Developed especially for use with Vega super-duty silica brick. This cement contributes materially to superior furnace performance and life in such furnace applications as open-hearth, electrical-steel, heating, glass-tank, copper reverberatory, copper-refining, and nickel-refining furnaces.

396 PROPORTIONING OIL BURNER

Anthony Co.—Bulletin 501 illustrates and describes in detail the Anthony Nebulyte proportioning oil burner. The air and oil flows are interlocked and metered by one operating lever for either manual or fully automatic operation. Bulletin contains applications, capacities, and other details. Included is a condensed catalog of other types of Anthony equipment.

397 STANDARD RATED FURNACES

Surface Combustion Corp.—A new illustrated bulletin, No. SC-151, describes the complete line of "Surface" Standard Rated Furnaces for every toolroom heat-treat requirement. Emphasizing methods of precise heat-treatment for maximum tool life, this bulletin describes controlled atmosphere furnaces and generators in addition to direct-fired, forced-convection, and pot furnaces.

398 BORING AND TURNING MACHINES

American Steel Foundries, King Machine Tool Div.—New 2-color catalogs, fully illustrated, containing complete description and specifications on King vertical boring and turning machines. Catalog K-1 covers machine sizes 30, 36, and 42 in.; Catalog K-2, sizes 52, 62, and 72 in.; Catalog K-3, sizes 84 and 100 in.; Catalog K-4, sizes 120 and 144 in.

399 TUBE CLEANERS AND TUBE EXPANDERS

Thomas C. Wilson, Inc.—A 48-page catalog No. 76-A covers mechanical tube cleaners. This catalog depicts many types and sizes of cleaners driven

250 HP
Down to
1/6
we've got them all!
You can choose from a complete line of alternating current industrial-type motors —standard or special—single or polyphase— for every job. Get fast delivery, no red tape. Call your local Howell representative or contact us direct.
HOWELL ELECTRIC MOTORS CO.
HOWELL, MICHIGAN

EVERY STEP A SAFE STEP WITH BLAW-KNOX GRATING
Everyone walks safely, confidently on Blaw-Knox Electroforged Steel Grating . . . the one-piece panels stay rigid and strong—without shimmy or shake —because there are no parts to work loose. Twisted cross bars provide sure footing under the most adverse conditions. For complete information, write for Bulletin 2365.
BLAW-KNOX GRATING
Industry's first choice for
• SAFETY • STRENGTH • LONG LIFE
• LOW UPKEEP • SELF-CLEANING
Grating Department
BLAW-KNOX DIVISION of Blaw-Knox Co.
2108 Farmers Bank Bldg.,
Pittsburgh 22, Pa.
BLAW-KNOX ELECTROFORGED STEEL GRATING

by air, water, steam, or electric. A comprehensive tube expander and accessory catalog is also available for expanders 1/4-in. OD and up.

400 MARKING TOOLS

M. E. Cunningham Co.—Bulletin J 547 describes the Cunningham line of "Safety" marking tools. It illustrates the standard line of marking devices and includes symbol charts and special codes.

401 CRANE TRUCKS

Baker Industrial Truck Div., Baker Raulang Co.—Bulletin 1613 describes Baker model CXB and CXF locomotive-type crane trucks. Model CXB has a rated capacity of 6000 lb at 7-ft radius. Model CXF's rated capacity is 10,000 lbs at 5½-ft radius. Complete engineering specifications and drawings are included, along with action photographs that show these trucks at work in a variety of applications.

402 OIL BURNERS

Ray Oil Burner Co.—A condensed 16-page catalog in color, with illustrations, capacity table, and listing the company's commercial and industrial oil and combination gas-oil burners, including: fully automatic, semiautomatic, and manually controlled horizontal rotary types and steam turbine drive; commercial and domestic pressure atomizing types for oil or combination gas-oil.

403 PRESSURE REGULATORS

Chapiin-Fulton Manufacturing Co.—Bulletin 46 describes Model 46 pressure regulator. Two new features are used in this design: The O-Ring to replace the stuffing box, and the "Dynaknob" to improve the degree of accuracy in outlet pressure control.

404 WATER GAGES

Ernst Water Column & Gage Co.—New bulletin 10-1-51R illustrates all types of high-pressure gage glasses for boilers, tanks, heaters, etc. Also includes safety glass protectors, illuminators, try cocks, and compressed carubestos valve disks.

405 TECHNICAL BOOKS

The American Society of Mechanical Engineers—1953 Catalog of ASME Publications. A 20-page descriptive price list of current books, standards codes, research reports, and periodicals published by the Society.

406 AUTOMATIC VALVES AND FLOW TUBES

Foster Engineering Co.—New 8-page catalog, illustrated CC has selector chart giving characteristics of various types of automatic valves for quick selection of pressure regulators, temperature regulators, pump governors, safety valves, relief valves float valves, etc. Also, head capacity curves for flow tubes.

407 SHADED POLE MOTORS

Fisco Industries, Inc.—Catalog describes full line of shaded pole motors of the 2, 4, and 6 pole types, ranging from 1/100 to 1/8 hp. Dimensions, electrical characteristics, and curves are included. All motors manufactured are suited for use on either 110 or 220 volt, 60 cycle, current.

408 PNEUMATIC ATOMIZING NOZZLES

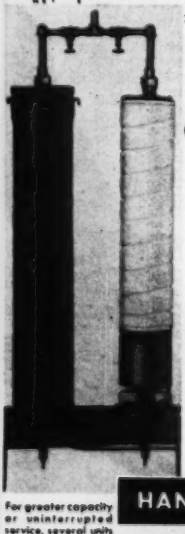
Spraying Systems Co.—11-page illustrated catalog No. 23 lists wide range of types, sizes, and materials as standard equipment to meet exact needs in capacities, spray types, and characteristics for atomizing any liquid that flows; for industrial and chemical processing and scientific research.

409 AUTOMATIC VALVES AND CONTROLS

A. W. Cash Co.—Bulletin No. 330, reviews in the briefest possible manner the more commonly used valves, regulators, and controls for pressure regulating, volume flow, and liquid level. The illustrations and descriptions shown in the bulletin, brief as they are, will show the broad scope of automatic control and suggest the possibilities which proper application of these devices can serve.

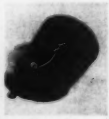
The "Buyer's Catalog Guide" offers readers of MECHANICAL ENGINEERING an opportunity to secure advertisers' latest industrial literature available. In this issue there are 409 items to make selections from. For convenience an index may be found on pages 43 and 44. Select desired catalogs by number, fill in coupon on page 44 and mail promptly. *(Must be mailed on or before date given on coupon.)*

KEEP YOUR INSTRUMENTS FREE FROM DIRT AND MOISTURE



HANKISON
Model A-100
Condensifilter

A LOW DEW POINT IS ESSENTIAL for instrument air. CONDENSIFILTERS REDUCE DEW POINTS. Condensing section cools air; condenses water and oil vapors. Filter cartridge removes dirt and solid matter. Trap automatically discharges collected contamination. Model A-100—100 scfm capacity at 100 psig.



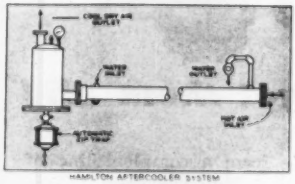
Condenser where temperature and dew point are reduced.

Write For Bulletin A-100

For greater capacity or uninterrupted service, several units can be installed in parallel.

HANKISON Corporation
1009 BANKSVILLE ROAD
PITTSBURGH 16, PA

If you are up in the air about what to buy
Come down to earth where the air is dry.



HAMILTON AFTERCOOLER SYSTEM

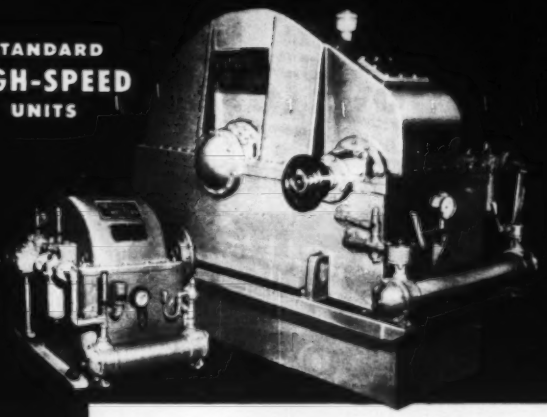
MURPHY AFTERCOOLER SYSTEM

The Hamilton Aftercooler System is of the counter current flow design, for the greatest efficiency in cooling compressed air to within a few degrees of the cooling water; the cooled air then enters the regular patented Type A Murphy Automatic Separator where moisture is ejected through the automatic Zip Trap and cool dry air is delivered to the distributing lines.

Write for literature—send us your layout for free engineering assistance with special problems.

AFTERCOOLERS • SEPARATORS • STRAINERS • TRAPS
SPRAY GUNS • PISTOL SPRAYERS
JAS. A. MURPHY & CO.
400 VINE STREET HAMILTON, OHIO
Moisture Elimination Up To 3000 Pounds Per Square Inch

STANDARD
HIGH-SPEED
UNITS



SPECIAL
HIGH-SPEED
UNITS

GEAR DRIVES

custom engineered or standard

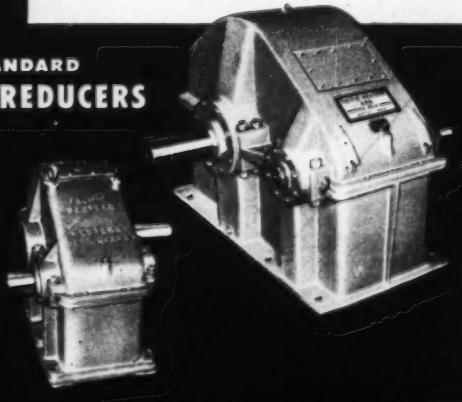
Complete services by Western Gear Works include the design, production, testing, and application of all types of gear drives for all industries.

WESTERN GEAR

"Good Gears Since 1888"

SPECIAL
AIRCRAFT
ACCESSORY DRIVES

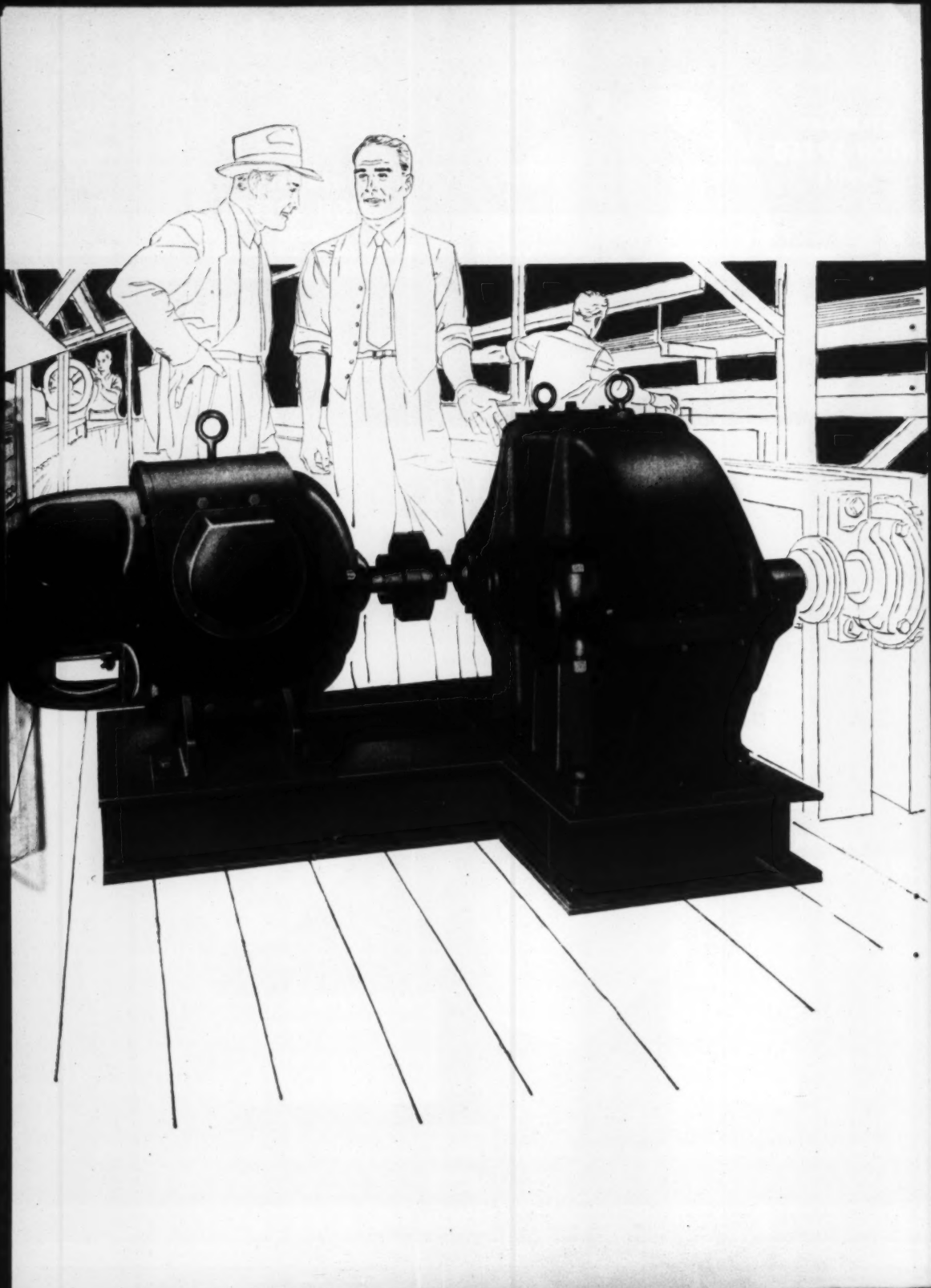
STANDARD
SPEED-REDUCERS



New Catalog Available —
Send for general bulletin 5200, or request specific product information if you wish.

WESTERN GEAR WORKS
Manufacturers of **PACIFIC-WESTERN** Gear Products
Plants: Seattle, San Francisco, Belmont, Lynwood, Houston

Pacific Gear & Tool Works



"I'll tell you why we buy these Westinghouse Drive Teams"

"We obtain exclusive benefits from the planning stage right on through the long life of the drive. You see, experienced Westinghouse Application Engineers know both mechanical and electrical drive problems. When we put our heads together, we always come up with a better drive solution.

"We also benefit every step of the way from ordering to maintenance because there's only one point of contact required—undivided responsibility. Westinghouse ability and willingness to handle our complete drive requirements sure saves us plenty of headaches. Saves our time and dollars, too.

"Experience has shown us that we can depend on a Westinghouse Speed Reducer. The taper-hardened, accurately hobbed gears, the rugged tight case, the efficient roller bearings, the positive lubrication system—all add up to a speed reducer that is second to none.

"The Life-Line d-c motor deserves its share of the credit, too. The features we especially like are the pre-lubricated bearings and the all-steel construction. We install a Life-Line motor and forget it."

The next time you have a drive problem, call in your Westinghouse representative. Remember—Westinghouse makes the complete drive.

Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

J-07307

valve values
PHOTO NEWS

MICROMEASURING...

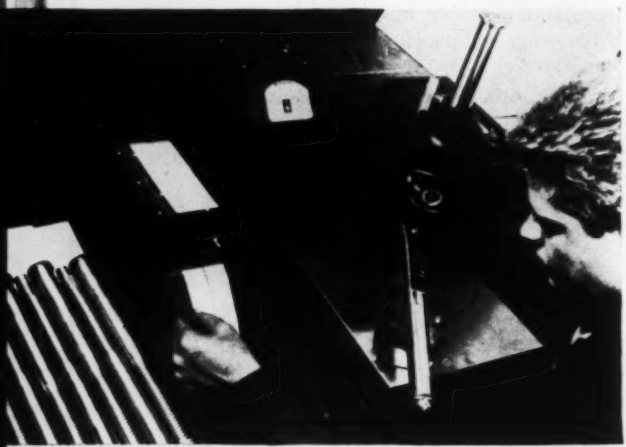
Edward Dimensional Control In Action

The young lady at right is operating the Micronoscope, a unique measuring device developed by Edward to check the all-important seat-disk joint on steel valves. Exclusive with Edward, this high vacuum inspection tool detects minute variations in surface finish and concentricity. If the joint is not vacuum-tight it is rejected!

Here at Edward we're well equipped with measuring devices of all types—and we use them often. For example, the components that make up each of the Fig. 7543 blow-off valves illustrated on the opposite page get 196 dimensional checks during manufacture. Regular inspections on all valves are performed at every manufacturing step by highly trained inspectors whose only responsibility is to double-check on the precision of our machines and men.

All this has a dollars and cents value for you. For this manufacturing accuracy, when added to Edward design and metallurgical leadership, results in valves that give long dependable service free from expensive shut-downs or high maintenance cost.

At Edward, the latest developments in optics, electronics, and other sciences are constantly searched for better methods of dimensional control. Above, optical contour projector magnifies image of stem for Fig. 952 instrument valve 62½ times, permits checking all tolerances to one ten-thousandth of an inch, all angles to one minute. Below, electrically operated Pratt & Whitney standards machine measuring accurately to within .000010 of an inch is used to check thread gage.



Electronic surface analysis test of stems for Fig. 4828 valves. Surface variations are measured in millionths of an inch, reproduced on chart in inspector's hand.

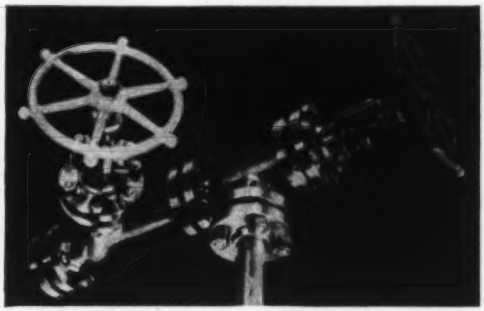
Edward Valves, Inc. Another Product

HOW TO SELECT AND OPERATE BLOW-OFF VALVES

A few special precautions in selecting and operating your blow-off valves will prolong their life, cut down on maintenance, and avoid trouble. For example:

1. Select two valves of identical design. This will permit interchangeability of parts.
2. During blow-down periods, first open the valve nearest the boiler wide, then slowly open the valve furthest from the boiler. In shutting down the valves, close the valve furthest from the boiler first, then close the valve nearest the boiler.

   This operating sequence places most of the wear on the valve furthest from the boiler and insures that a good tight valve is found nearest the boiler at all times. Should the valve furthest from the boiler, which is used as the blowing valve, show signs of excessive wear, seat erosion, etc., it can be removed from the line and repaired or replaced



   without shutting down the boiler, while the valve nearest the boiler maintains boiler pressure.
3. Pick blow-off valves with the packing far removed from the high temperature zone. An extra feature in Edward valves is a positive backseat which seals off packing from the high temperature area.
4. Avoid gadgety-involved designs in selecting your blow-off valves. You're interested in long dependable service, not in trick construction.
5. The blowing valve should not be opened too quickly in order to avoid damaging shock to piping. Edward blow-off valves are of a special slow opening variety, and can be opened at normal speed, eliminating the possibility of error by inexperienced operators.

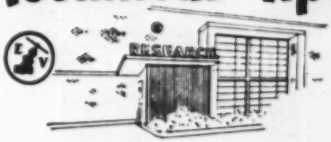
Many of your blow-off problems can be eliminated by selecting Edward valves, veterans of nearly fifty years of service in blow-off applications. With Edward you get a functionally simple design for greatest dependability. The use of identical valves permits maximum piping flexibility and interchangeability of parts. Disk is elevated from seat on operating instead of grinding against it, eliminating the possibility of seat-disk galling.

Provided in ASA pressure classes for 300, 600, 900 and 2500 lb, sizes 1½", 2", 2½"—straightway or angle, flanged or socket welding ends. Stellite or EValloy trim. Write for Catalog 12-D.

EDWARD VALVES, Inc., *Subsidiary of*
ROCKWELL MANUFACTURING COMPANY
1350 W. 145th STREET • EAST CHICAGO, INDIANA

GLOBE AND ANGLE STOP • FEED-LINE • BLOW-OFF • NON-RETURN CHECK • GATE • GAGE AND INSTRUMENT • RELIEF • STRAINERS

Technical Tips



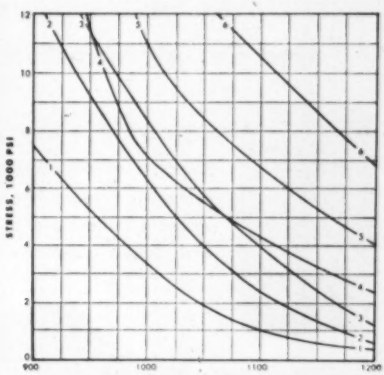
"Creep" Robs Metal Strength At High Temperatures

Steels stressed in a high temperature range show an unusual behavior—over a period of many days or years they may slowly stretch or bend out of shape. This phenomena is known as "creep". Some plastics do this at room temperature.

"Creep strength" rather than tensile strength limits the use of metals in valve design for high temperature use. This "creep strength", expressed in psi, refers to the load that can be carried by a metal without excessive plastic flow. The limiting plastic flow is most commonly considered as an increase in length of 1 per cent in 100,000 hours of time.

A single creep test must be run for 1,000 hours or more to measure this small rate of plastic flow. Each new type of metal to be investigated must be tested at several different loads to find the one which will most nearly cause plastic deformation at a rate of 1 per cent in 100,000 hours. Each set of tests must be repeated at several temperatures to cover the operating range in which the steel might be used. Hence, ten to twenty tests of 1,000 hours each are needed to find the creep strength of a single type of steel.

The creep strengths of six different steels often used in valve bodies for high temperature service are shown below.



CREEP STRENGTH VS TEMPERATURE

1. Low Carbon Steel
2. Carbon——0.50% Molybdenum Steel
3. 1.25% Chromium——0.50% Moly. Steel
4. 2.25% Chromium——1.00% Moly. Steel
5. 18% Chromium——8% Nickel Steel
6. 18% Chromium—8% Nickel—Mo. Steel

Creep testing in Edward laboratories.

Edward

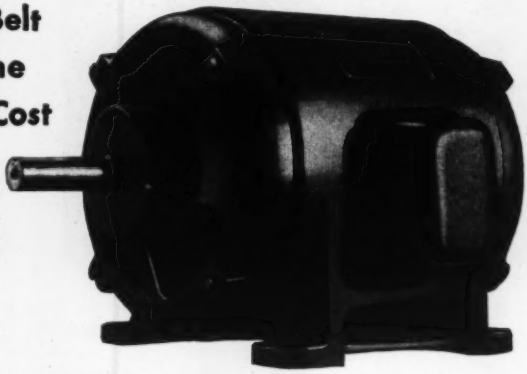
ALLIS-CHALMERS

Simplify YOUR DRIVE DESIGN PROBLEMS

Allis-Chalmers Matched Motors, Control and V-Belt Drives Save Design Time and Cut Manufacturing Cost

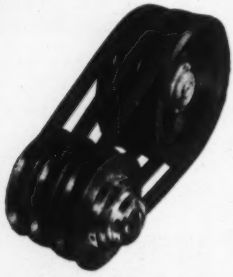
CONTROL

Complete matched control for any motor, including manual and magnetic starters, pushbuttons, and variable speed control.



MOTORS

Standard open drip-proof, splash-proof, totally-enclosed, fan-cooled and explosion-proof, ½ hp and up. Also wound rotor and direct current. Special motors to meet your requirements.



Texrope V-BELT DRIVES

Fixed speed and *Vari-Pitch* sheaves with stationary or motion control. Famous grommet belt construction. Most complete line of V-belt drive equipment in the industry.

Get the Kind of Help You Need

Allis-Chalmers representatives in every industrial center are at your command. Just call the office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin for helpful literature.

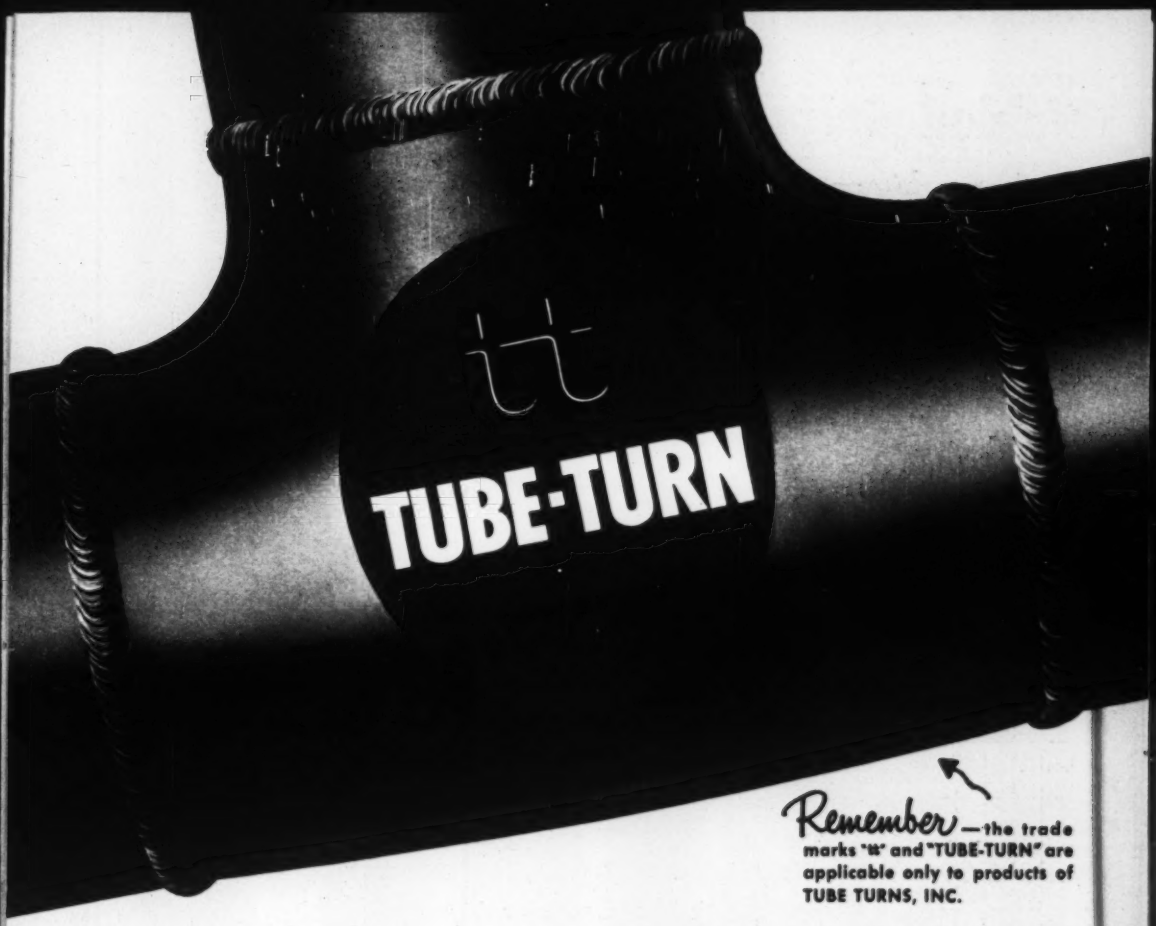
Allis-Chalmers Motors and Control	51B6052
Texrope V-Belt Drives	20B6051

Texrope and *Vari-Pitch* are Allis-Chalmers trademarks.

A-3640

ALLIS-CHALMERS

A-C ALLIS CHALMERS



Remember—the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.

Engineered for extra strength

An important value you get with TUBE-TURN Welding Fittings and Flanges is extra strength . . . at no extra cost.

For example, this TUBE-TURN Welding Tee will withstand more pressure than required by standard codes . . . because it is drawn from seamless tubing to a barrel shape, and because of its generous crotch radius and thickness. Bursting pressures obtained in tests of representative fittings have averaged more than 25% higher than code requirements.

For this extra quality get in touch with your nearby TUBE TURNS' Distributor. You'll find one in every principal city.

Scrappy says: "Aid defense—more scrap today . . . more steel tomorrow."

Write Dept. O-11 for free booklet on Allowable Working Pressures. Use coupon on reverse side.

Be sure you see the double "tt"

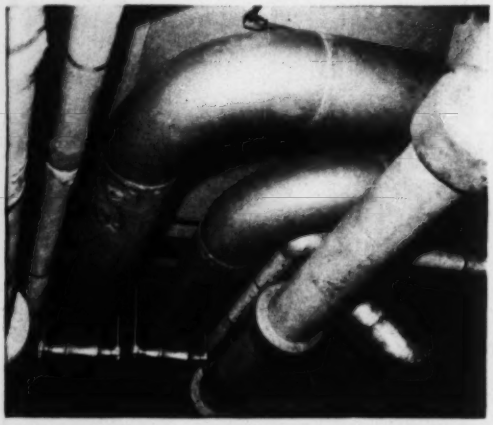
TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York · Philadelphia · Pittsburgh · Chicago · Houston · Tulsa · San Francisco · Los Angeles
TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO . . . A wholly owned subsidiary of TUBE TURNS, INC.

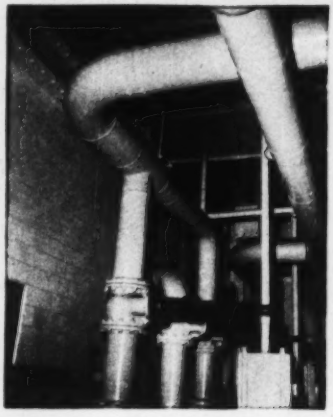
Welded piping system serves New York Stock Exchange

Long the financial capital of the world, the New York Stock Exchange was one of the first commercial buildings to have controlled atmosphere. Recent additions provide efficient, modern air conditioning to keep the financial mart comfortable at all times.

New installations have been made with a minimum of fuss, in limited space, by use of compact welded piping systems. With TUBE-TURN Welding Fittings used to make directional changes, a permanently leakproof system is assured.



Use of welded piping simplified installation in cramped quarters. Welded lines can be fitted closely together, make a neat installation. Welders like to use TUBE-TURN Welding Fittings, because their consistent dimensional accuracy makes line-up easy, particularly important where space is at a premium.



These 10" and 14" lines carry condenser water to the building's cooling tower. Selection of TUBE-TURN Welding Fittings assures optimum flow conditions, and provides a permanently leakproof system.

TUBE TURNS, INC., Dept. O-11
224 East Broadway, Louisville 1, Kentucky

Your name .....

Position .....

Company .....

Nature of business .....

Address .....

City ..... *State* .....

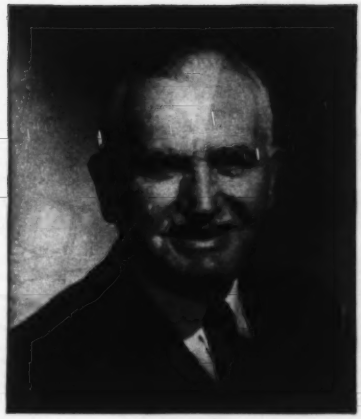
DISTRICT OFFICES

New York	Houston
Philadelphia	Tulsa
Pittsburgh	San Francisco
Chicago	Los Angeles

"tt" and "TUBE-TURN" Reg. U. S. Pat. Off.

TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY



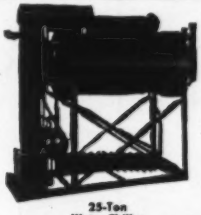
"I compared them all and chose Servel Air Conditioning equipment!"

Make Your Own Point-for-Point Test And Discover Servel's Amazing Extras!

No other installation offers all these amazing features	SERVEL	OTHER
No Compressor—no vibration, quiet, no moving parts to wear.	✓	
Light Floor Loading—no need for special foundation or floor braces.	✓	

No other installation guarantees such lasting performance	SERVEL	OTHER
Pressure Free—refrigerating system operates under a vacuum. Conforms to building codes without extra expense.	✓	
Choice of Energy Source—use present steam source under any pressure . . . or use gas, oil, LP gas, even waste heat.	✓	
Minimum Maintenance—factory guaranteed for five full years.	✓	
Lighter per Ton of Capacity—can even be installed on the roof.	✓	

All-Year Air Conditioner



25-Ton Water Chiller

SELECT SERVEL . . . the air conditioning that offers low operating cost, guaranteed dependability, in residential, commercial or industrial installations.

Servel

AIR CONDITIONING

Made by the makers of the famous Servel Refrigerator

SERVEL, INC. • Evansville 20, Indiana

Get all the facts and you'll get Servel!
Write for complete information today!

Servel, Inc., Dept. ME-11, Evansville 20, Indiana

Gentlemen:
I'm interested in the dependability and low operating cost of Servel Air Conditioning. Send me full details on

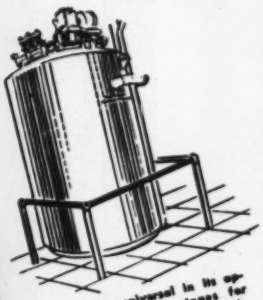
☐ Industrial ☐ Commercial Units

*NAME*_____

*FIRM*_____

*ADDRESS*_____

*CITY*_____ *ZONE*____ *STATE*____



Worm gearing — universal in its application — affords advantages for almost every power transmission job. The Cleveland VD unit atop this 275 gallon tank drives a stainless steel agitator which mixes Ilotin (Insulin-Lilly) for Eli Lilly and Company, Indianapolis, Indiana.

CLEVELAND whips problem of uniform solutions

INSULIN solution to the tune of 275 gallons per batch is mixed in this jacketed stainless steel tank. The agitator is driven by a Cleveland Type VD speed reducer —a worm gear unit whose steady performance helps to insure uniformity in the dilutions processed.

For forty years, Clevelands have mixed in the best companies, in the chemical and allied industries. In fact, wherever the need for a dependable vertical or horizontal right-angle drive arises, there you'll likely find Clevelands at work, operating dryers and kilns, screw conveyors, bucket elevators, mixers and agitators, as well as other industrial equipment.

For full information to help solve your own power transmission problems, send now for new Catalog 400. The Cleveland Worm and Gear Company, 3264 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Ltd.

CLEVELAND

Speed Reducers

R-S Valve Facts

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •

For Operating Ease in Inaccessible Locations

INSTALL R-S CHAINWHEEL VALVES

Few Chainwheel Turns. R-S Valves are completely closed from the fully open position by the movement of the valve vane through 77½° of arc. Operating ease is one of the chief advantages of R-S Valves.

Economy in First Cost. R-S narrow face-to-face design results in minimum number of working parts, less metal, less machining, lower weight and less supporting structure—hence economy in first cost.

Accurate Engineering. Body assemblies are accurately engineered mechanically and metallurgically. A. S. A. standards are equaled or exceeded in every detail.

Low Pressure Drop Saves Power. In the open position the streamlined vane causes a Venturi action. Pressure drop is therefore exceptionally low. Pumping costs are reduced accordingly.

More Control Rangeability. Power-controlled prime movers delivering 15 foot-pounds to 38,000 foot-pounds of torque open or close at any desired speed. Full closure requires one second to ten minutes depending on requirements and the type of material controlled. Positive shut-off is obtained with a rubber seat.

Self-cleaning. There are no pockets to house sediment, no change of flow direction to create turbulence or wire drawing and therefore less likelihood of erosion and cavitation.

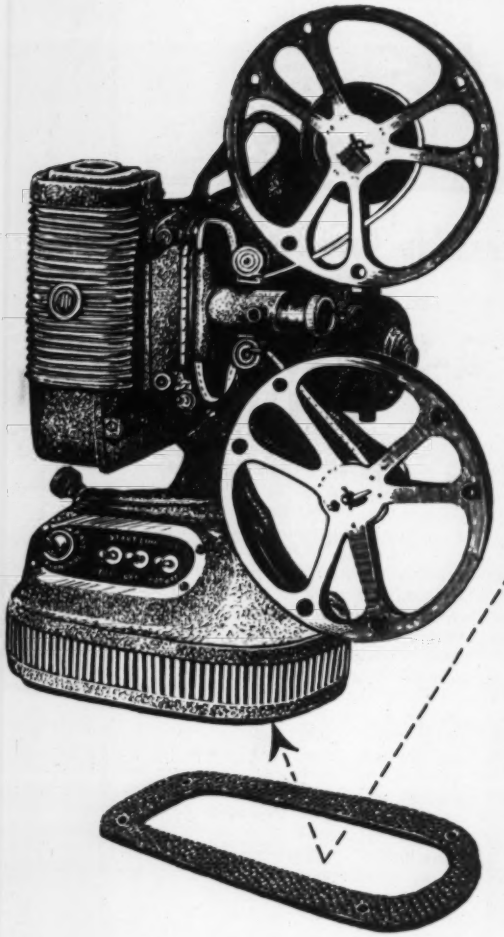
Maintenance Practically Nil. Every R-S Valve is designed and constructed for rugged service and provided with safety factors to give complete satisfaction in the service for which it is designed. Packing trouble is not common to R-S Valves since the shaft moves only with an oscillating motion.

Consult your local R-S Valve Engineers, or write direct.

R-S PRODUCTS CORPORATION • 4600 Germantown Ave., Philadelphia 44, Pa.

An S. Morgan Smith Company Subsidiary

DISTRICT OFFICES IN PRINCIPAL CITIES



extra performance

at less cost with

SPONGEX CELLULAR RUBBER

DeJUR 8 mm. movie projector uses SPONGEX base to dampen vibration, prevent crawling and protect surfaces.

A simple die-cut shape from Spongex sheet stock, gives DeJUR owners a projector that has less motor vibration, sits more firmly and will not crawl on smooth surfaces.

This inexpensive extra wins thousands of friends for DeJUR. Perhaps your product could use Spongex to increase its efficiency, reduce costs or give better service.

There are literally hundreds of uses for Spongex sheet stock. You can cut your own applications from Spongex sheets or rolls—or we'll die-cut to specification.

If you need cellular rubber with special qualities—such as flame resistance, oil resistance—performance under high or low temperature—there's a Spongex sheet stock compounded for the job.

SPONGEX® Cellular Rubber

used for cushioning, insulating, shock absorption, sound and vibration damping, gasketing, sealing, weatherstripping and dust proofing.

THE SPONGE RUBBER PRODUCTS COMPANY

501 Derby Place, Shelton, Conn.

OILITE Finished Machine PARTS Assure YOU

- ★ No Tooling on Your Part.
- ★ Fast Delivery (Normally two (2) to six (6) weeks).
- ★ Accurate Parts (Machine Tool Tolerances).
- ★ Low Cost (Less than Machined Parts).
- ★ An Engineered Product.
- ★ Greater Freedom in Design.
- ★ Broad Range as to Size and Materials.
- ★ Consultation with Field Engineers.
- ★ The Benefit of More than Twenty (20) Years of Powder Metallurgy "KNOW-HOW."

We are told—"OILITE is the Favorite"

AMPLEX MANUFACTURING COMPANY

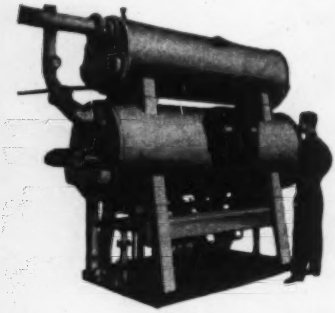
Subsidiary of Chrysler Corporation

Detroit 31, Michigan

FIELD ENGINEERS AND DEPOTS THROUGHOUT UNITED STATES AND CANADA

Oilite Products Include: Bearings, Finished Machine Parts, Cored and Solid Bars, Permanent Filters and Special Units.

Copyright 1952—The Chrysler Corp.



Looking for a lightweight with a heavyweight punch?

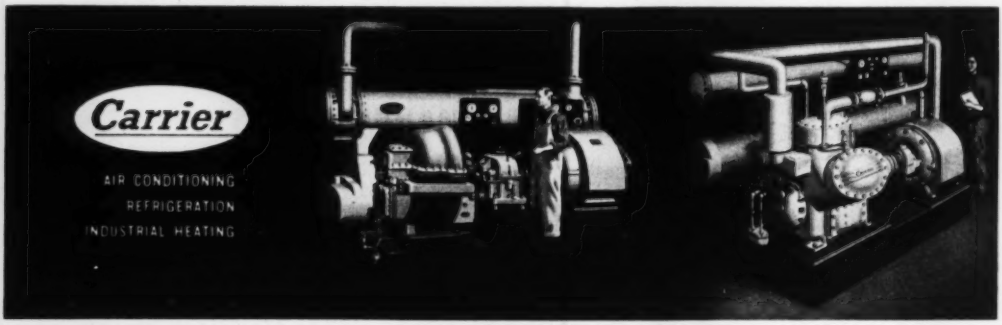
Then look at the Carrier Absorption Refrigerating Machine. Lightweight enough to be installed on roofs or intermediate floors without heavy foundations, it has the capacity to do a heavyweight job. Comes in five sizes, from 115 to 350 tons, adaptable for multi-unit installations.

This Carrier machine cools with steam by absorption. High pressure or low pressure steam. Waste steam from other plant equipment. Steam from a boiler that operates at reduced capacity during the summer months. It uses steam at a rate of less than 20 lbs. per hour per ton of refrigeration.

With no major moving parts, it needs no highly skilled operator. Its refrigerant is the cheapest anyone ever heard of — water. And its absorbent is a simple salt — won't burn or explode.

It handles partial loads automatically and operates at high efficiency from full load down to 10% of capacity.

You can see the advantages. Maybe they fit your needs. If you'd like to know more, check the nearest Carrier office. Or write for our booklet, "Absorption Refrigerating Machines." Carrier Corporation, Syracuse, New York.



The Centrifugal Refrigerating Machine (left) and the packaged Reciprocating Refrigerating Machine (right) also provide cooling for industrial processes or comfort air conditioning and both offer unique advantages. Like all Carrier equipment, they carry with them Carrier's experienced service—quick and dependable. Always, Carrier is your best investment.

Draftsmen work better, faster with this machine...

PHOTOS BY COURTESY OF THE UNIVERSAL DRAFTING MACHINE CORPORATION

By holding spindles absolutely rigid and keeping motion friction-free, Fafnir Ball Bearings contribute much to the vernier accuracy and effortless action of the Universal "Boardmaster". The ultimate results are more accurate sketches, layouts or detailing and "on the nose" template work in faster time . . . so important when good engineers and draftsmen are scarce.

At three pivot points, pairs of extra-light, compact single row, Fafnir Ball Bearings give finger touch ease of movement without a trace of play. At the "centralized control unit", a large diameter Fafnir Bearing is used together with paired, preloaded and pre-lubricated Fafnirs. Six of the seven Fafnir Bearings used are Plya-Seal Type, which prevent lubricant leakage, keep out contaminants, and are lubricated for life.

The faculty for providing custom-made types of bearings out of stock . . . from the most complete line in America . . . makes Fafnir the first source consulted by leading manufacturers. Maybe you can solve bearing problems this easy way. The Fafnir Bearing Company, New Britain, Conn.

Standard Radial Bearings

Wide Inner Ring Ball Bearings with Mechani-Seals

Plya-Seal Type Bearings

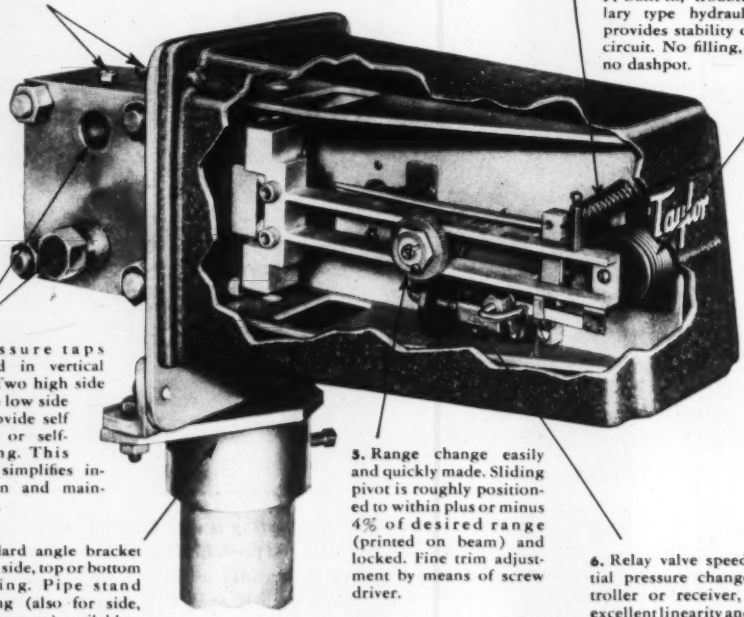
Taylor announces

1. Dry meter operates on force-balance principle. Diaphragm of Teflon coated glass cloth. Body working pressure rating 1500 psi. Available in either forged steel or type 430 stainless steel.

2. Vent screws to provide for total filling in liquid service.

8. Provision for adjustment of range suppression up to 100%.

7. Built-in, trouble-free, capillary type hydraulic damping provides stability of pneumatic circuit. No filling,—no mess—no dashpot.

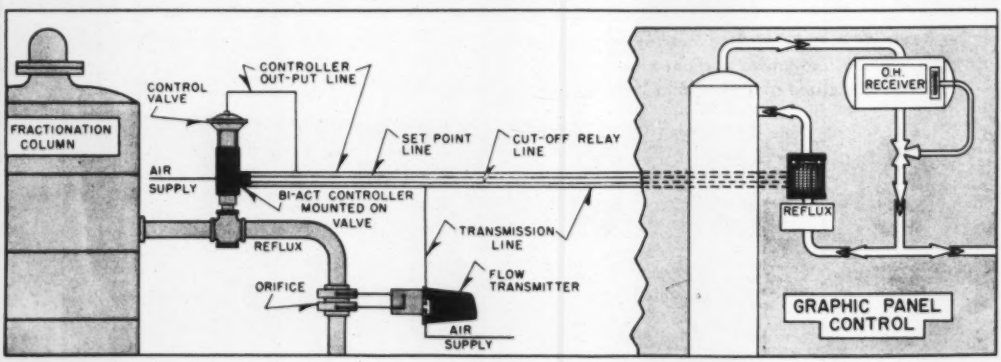


3. Pressure taps mounted in vertical plane. Two high side and two low side taps provide self venting or self-draining. This feature simplifies installation and maintenance.

4. Standard angle bracket permits side, top or bottom mounting. Pipe stand mounting (also for side, top or bottom) available.

5. Range change easily and quickly made. Sliding pivot is roughly positioned to within plus or minus 4% of desired range (printed on beam) and locked. Fine trim adjustment by means of screw driver.

6. Relay valve speeds differential pressure changes to controller or receiver, providing excellent linearity and minimum hysteresis.



SIMPLIFIED FLOW MEASUREMENT

With the NEW Taylor TRANSAIRE® Differential Pressure Transmitter

INEXPENSIVE AND SIMPLE TO INSTALL

1. Simplified piping because it can be close coupled to orifice flanges.
2. No leveling—mercuryless dry meter.
3. Side, top or bottom bracket mounting; available with 2″ pipe stand.
4. No seal pots required—negligible displacement because of force balance construction.
5. Light weight for easy handling; weighs only 23 lbs.
6. Vent screws for simple, solid filling.

ECONOMICAL—EASY TO MAINTAIN

7. Self draining or venting—no periodic manual venting or draining.
8. Mercuryless — flexible but tough Teflon coated glass fabric diaphragm.
9. Overrange protection to full body rating.
10. Purges, if required, can be installed to keep body swept clean.
11. Simple range change by sliding pivot—screw driver trim.

ACCURATE

12. Relay valve for linearity, minimum hysteresis, fast speed of response.
13. Pressure effect 0.2% / 100 psi. change.
14. Temperature effect 1.0% / 100°F. change.
15. Self draining and venting. No errors build up during operation.
16. Damped pneumatic circuit—stable air output even on vibrating pipe lines.

RUGGED AND DEPENDABLE

17. Body forged steel or type 430 Stainless Steel. Working pressure rating, 1500 psi.
18. Weather proof housing built for tough service and outdoor mounting.
19. Force balance construction—negligible motion—minimum possible wear.
20. Process sealing bellows 3-ply type 316 stainless steel.

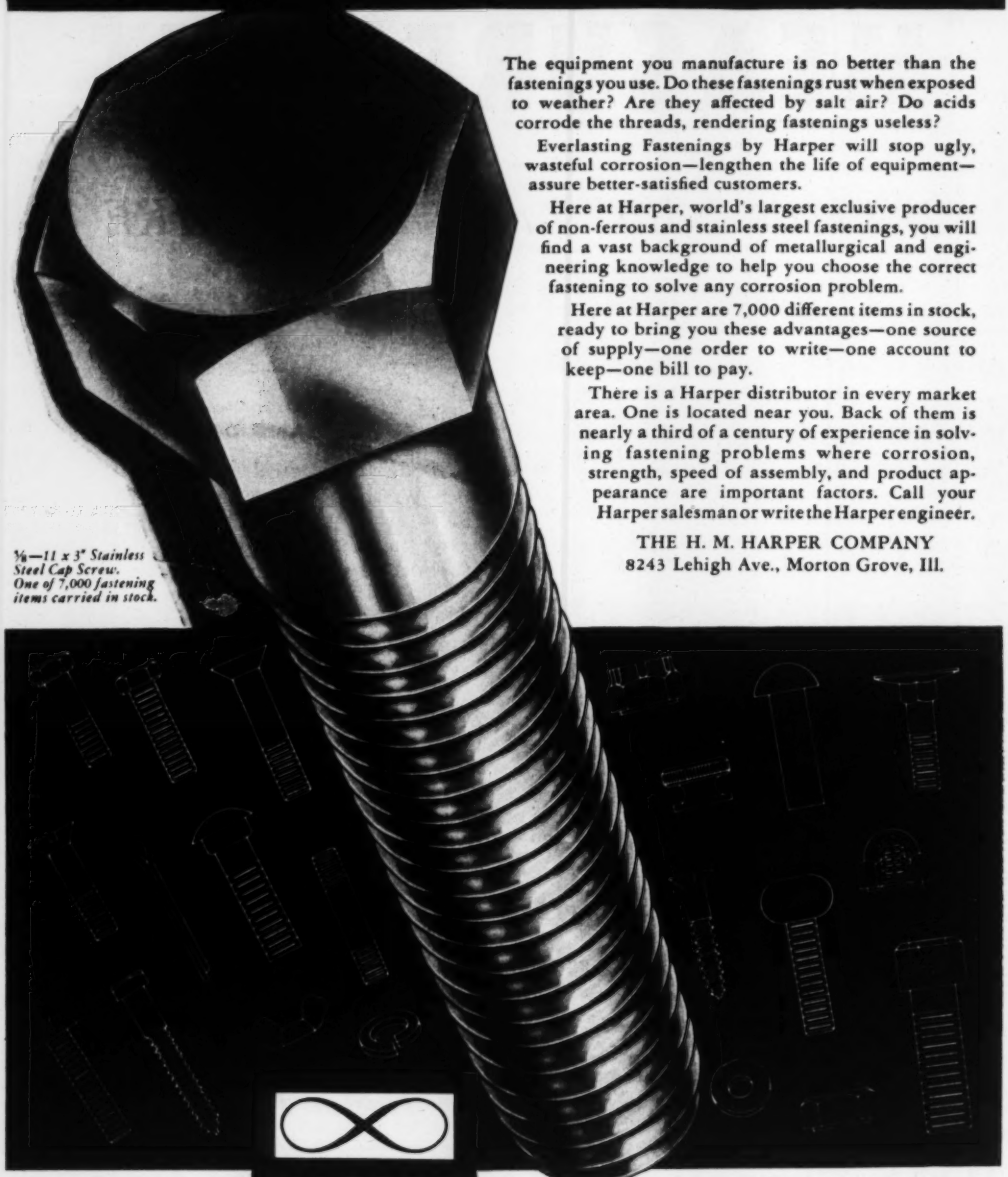
ADAPTABLE

21. 100% suppression—continuously adjustable from 0 to 100%. Ideal for liquid level applications.
22. Ten-to-one rangeability in each of two forms: a. 20-200″ water b. 80-800″ water.

Find out more about this new flow and liquid level transmitter. Ask your Taylor Field Engineer, or write for **Bulletin 98226.** Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.*

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

TROUBLE GOES OUT when HARPER FASTENINGS GO IN



⅛—11 x 3" Stainless Steel Cap Screw. One of 7,000 fastening items carried in stock.

The equipment you manufacture is no better than the fastenings you use. Do these fastenings rust when exposed to weather? Are they affected by salt air? Do acids corrode the threads, rendering fastenings useless?

Everlasting Fastenings by Harper will stop ugly, wasteful corrosion—lengthen the life of equipment—assure better-satisfied customers.

Here at Harper, world's largest exclusive producer of non-ferrous and stainless steel fastenings, you will find a vast background of metallurgical and engineering knowledge to help you choose the correct fastening to solve any corrosion problem.

Here at Harper are 7,000 different items in stock, ready to bring you these advantages—one source of supply—one order to write—one account to keep—one bill to pay.

There is a Harper distributor in every market area. One is located near you. Back of them is nearly a third of a century of experience in solving fastening problems where corrosion, strength, speed of assembly, and product appearance are important factors. Call your Harper salesman or write the Harper engineer.

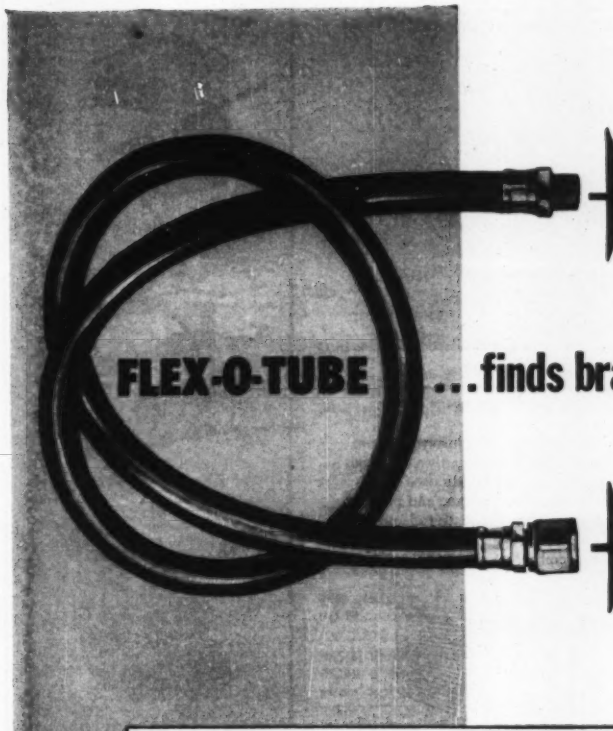
THE H. M. HARPER COMPANY
8243 Lehigh Ave., Morton Grove, Ill.

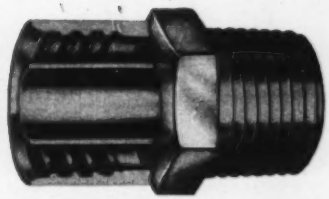
HARPER

EVERLASTING FASTENINGS

SPECIALISTS IN ALL NON-CORROSIVE METALS

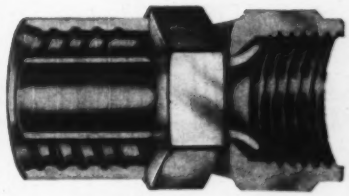
BRASS • SILICON BRONZE • NAVAL BRONZE • MONEL • ALUMINUM • STAINLESS STEEL





Flex-o-Tube Hose, and cross section of machined male fitting.

FLEX-O-TUBE ...finds brass makes fine fittings



Cross Section of machined and flared female fitting.

For quick, accurate and economical machining, free-cutting brass rod is preferred by many companies, such as Flex-O-Tube, Division of Meridan Corporation, Detroit, Mich. This company makes hose assemblies and fittings to conduct air-oil-water-gasoline and hydraulic power for the automotive, farm implement, machine tool and aircraft industries. Some of these hoses have a minimum bursting pressure of 20,000 pounds per square inch, which gives an indication of the tightness required, which can be obtained only by strength and accuracy.

Flex-O-Tube has found six points of superiority for brass over other metals, as follows:

1. Brass "flows," or is ductile, so that no cracks result during the crimping operation required to fasten the fittings to the hose.
2. Ductility and strength inherent in brass act to provide a superior seat to fittings designed to control fluid flow. Competitive metals are either too hard or too soft to give positive closing and tend to leak.
3. Where the design of the fitting is intricate, necessitating removal of considerable metal by machining, the automatic screw machines can be run faster with free-cutting brass rod.
4. Brass has a high scrap value, and the scrap sold back to the mill increases brass supplies.
5. The break-even point between brass and other metals is especially favorable to brass in the sizes of rod that Flex-O-Tube buys.
6. Customer preference is for brass, which is universally recognized as a quality metal. Hence brass fittings are more readily sold, and in fact often are specified regardless of size or price differentials.

Included in the Flex-O-Tube operations are machining, flaring, crimping, and annealing to assure the proper ductility for flaring and crimping.

Revere is an important supplier of brass rod to Flex-O-Tube, and has also collaborated with this customer through the Revere Technical Advisory Service.

If you wish information about brass and how one or more of the Revere brasses can add to the economy and saleability of your product, get in touch with the nearest Revere Sales Office. See your telephone directory or write direct.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

* * *

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. Sales Offices in Principal Cities. Distributors Everywhere.

SEE REVERE'S "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

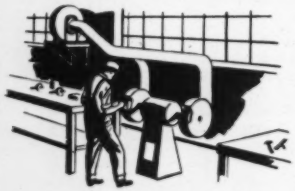
* * *

American Blower... a time-honored name in air handling

Philadelphia has a conveniently located American Blower Branch Office to provide you with data and equipment for air handling. You can reach American Blower in Philadelphia by calling Rittenhouse 6-8873. In other cities consult your phone book.

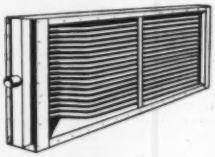
EMPLOYEE COMFORT

Fresh, invigorating air, indoors, does much to increase employee morale and efficiency. American Blower Ventura Fans are ideal for the job. They're attractively streamlined propeller fans with smooth-flowing lines that harmonize well with modern business interiors. Wiring is fully enclosed for safety. A square mounting panel makes them easy to install. All Ventura Fans are sound-rated and capacities are Certified.



ABRASIVE MATERIALS

If you've found dust from grinding machine operations hard to handle, American Blower Type V Fans are well worth investigating. The heavy cast-iron housing of Type V fans easily withstands the wear of hard, gritty, abrasive materials. Also, their volume and pressure range is more than adequate to handle the normal requirements of this type of work. Remember, good ventilation is good business.



HEATING COILS

Current demands for heating from business and industry are greater now than ever before – a good reason to take early action on American Blower Heating Coils. Whether you need coils for use in blast heating or zone reheating – you'll find the size and type to fit your needs in the American Blower line. All tubing is helically wound with copper or aluminum fins in 3 standard spacings. Casings are heavy galvanized steel; headers are die-formed steel.

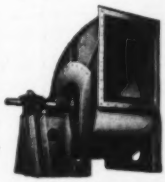
YOUR BUSINESS

Whatever your needs, American Blower heating, cooling, drying, air conditioning and air handling equipment will improve over-all comfort and efficiency in your business. For data, phone or write our nearest branch office.

Unit Heaters

Ventura Fans

Centrifugal Compressors



Industrial Fans

Utility Sets

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

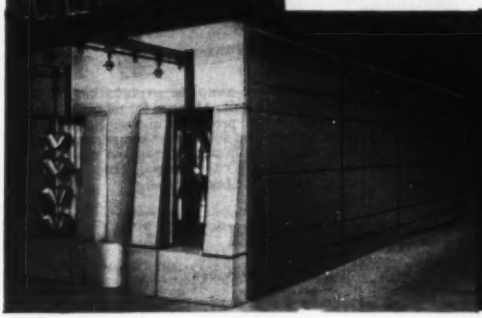
YOUR BEST BUY **AMERICAN BLOWER** **AIR HANDLING EQUIPMENT**

Serving home and industry: AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON

DESCRIPTION	JENSEN PAN-L-HEAT	COMPETITOR B	COMPETITOR C
CONSTRUCTION	26" x 84" panel—draw out or rigid mount with complete oven enclosure	11" x 44" strips rigid or caster mount	12" x 48" panel 24" x 48" panel rigid mount
INSULATION	Steel wall with 4" filled insulation and air cell	Steel wall and air cell	Heavy composition wall and air cell
ELECTRIC HEATERS TYPE AND RATING	Tubular GE CALROD ® Locking plug-in type 2000-watts	Glass lamp, bi-post base with flexible leads 500 or 1000-watts	Tubular metal with flexible leads 1800-watts
PRINCIPAL ENERGY WAVE BAND	Long infrared 6—120 μ	Short infrared 4—30 μ	Long infrared 6—120 μ
TYPE REFLECTOR DESIGN	Chemically brightened anodized aluminum optical contour	Gold plated steel optical contour	Unpolished aluminized steel corrugated
INITIAL RADIATION (*) OUTPUT 0°-90° ZONE; percent total energy input	Model A—67.1 Model B—59.7	83.2†	37.2—Full input 32.9—¾ input 28.4—½ input
PERCENT RADIATION IN (*) 20°-60° ZONE; VITAL TO HEATING UNIFORMITY	Model A—73.3 Model B—74.5	32.1	56.0
ESTIMATED CONVECTION OUTPUT—percent of input	Model A—30.0 Model B—37.0	14.0†	59.0—Full input 63.5—¾ input 68.0—½ input
TOTAL ENERGY INPUT (*) KW/sq. ft. at oven wall	Model A—2.77 Model B—1.106 (at full capacity)	1.19 (1000 W) 0.595 (500 W)	2.70—Full input 2.025—¾ input 1.35—½ input
INITIAL RADIATION OUTPUT—KW/sq. ft. at working plane	Model A—1.86 Model B—0.66 (at full capacity)	0.990 (1000 W) 0.495 (500 W)	1.005—Full input 0.666—¾ input 0.383—½ input
TEMPERATURE CONTROL	Full automatic temperature control to 700°F. (optional)	By repetition of heating load and time cycle	Manual control of input energy

*From reports prepared by Electrical Testing Laboratories—information available on request.

†Radiation diminishes to average 62% and convection increases to about 35% with normal use, due to absorption from exterior and interior contamination of glass bulb thru life. Frequent cleaning desirable.



SPECIALTIES, INC.

PAN-L-HEAT

How would YOU solve these two problems?

POSITIVE BRAKE-ACTION, so essential to public safety, is aided by use of the Permafuse Corporation's special brake-bonding oven. Installed in progressive service stations, the Permafuse oven fuses the adhesive-coated brake lining to the brake shoe evenly and permanently. A low-cost, rugged THERMOSWITCH® unit keeps oven temperature constant for proper bonding and keeps service calls to a minimum.

PREVENTION OF SPOILAGE in refrigeration applications is a matter of constant, exact temperature control. In the Jewett Hospital Blood Bank, for example, temperature is maintained at 37°F within plus or minus 2 degrees. Two Fenwal THERMOSWITCH thermostats serve as an alarm device, warning instantly against freezing or refrigeration failure if temperature goes below 32° F or above 48° F.

A FENWAL THERMOSWITCH CONTROL may solve your problem, too. Its external, single-metal shell expands or contracts *instantly* with temperature changes, making or breaking enclosed electrical contacts. Compact, highly resistant to shock and vibration, Fenwal THERMOSWITCH units have solved hundreds of problems where heat is a factor.

SEND FOR THIS CATALOG for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. Write Fenwal, Incorporated, 511 Pleasant Street, Ashland, Mass.

Fenwal

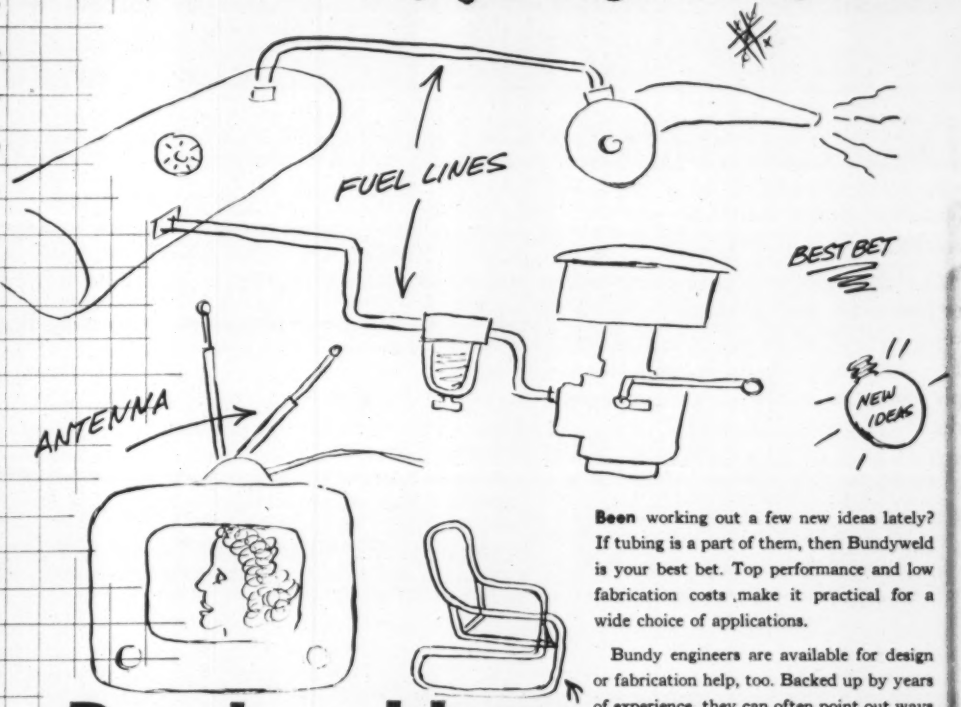
THERMOSWITCH®

Electric Temperature Control and Detection Devices

SENSITIVE... *but only to heat*

Bundyweld "Doodles"

to jog a designer's imagination



Been working out a few new ideas lately? If tubing is a part of them, then Bundyweld is your best bet. Top performance and low fabrication costs make it practical for a wide choice of applications.

Bundy engineers are available for design or fabrication help, too. Backed up by years of experience, they can often point out ways to save you time, material and money. Write for a catalog today.

Bundy Tubing Company, Detroit 14, Michigan.

WRITE

Bundyweld® Tubing

DOUBLE-WALLED FROM A SINGLE STRIP

Leakproof
High thermal conductivity
High bursting strength
High endurance limit
Extra-strong
Shock-resistant
Ductile
Lightweight
Machines easily
Takes plastic coating
Scale-free
Bright and clean
No inside bead
Uniform O.D., I.D.

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness, and

passed through a furnace. Copper coating fuses with steel. Result . . .

Bundyweld, double-walled and brazed through 360° of wall contact.

NOTE the exclusive patented Bundyweld beveled edges, which afford a smoother joint, absence of bead and less chance for any leakage.

Bundy Tubing Distributors and Representatives: Cambridge, 42, Mass.: Austin-Hastings Co., Inc., 226 Binney St. • **Chattanooga 2, Tenn.:** Pelrson-Deakins Co., 823-824 Chattanooga Bank Bldg. • **Chicago 32, Ill.:** Lapham Hickey Co., 3333 W. 47th Place • **Elizabeth, New Jersey:** A. B. Murray Co., Inc., Post Office Box 476 • **Philadelphia 3, Penn.:** Ruton & Co., 1717 Sansom St. • **San Francisco 10, Calif.:** Pacific Metals Co., Ltd., 3100 19th St. • **Seattle 4, Wash.:** Eagle Metals Co., 4755 First Ave. South **Toronto, Ontario, Canada:** Alloy Metal Sales, Ltd., 181 Fleet St., E. • **Bundyweld nickel and Monel tubing is sold by distributors of nickel and nickel alloys in principal cities.**

Cut drafting costs... Get better prints...

with Kodagraph Reproduction Materials... created for use in your present equipment

DRAFTING COSTS go down when you use Kodagraph Reproduction Materials to protect valuable drawings from wear and tear... to reclaim old, soiled, faded originals... to revise or combine drawings... to copy prints.

And the legibility of your direct-process prints or blueprints goes *up* when you use Kodagraph reproductions of your drawings in print-making. For Kodagraph Materials are silver sensitized, photographic... have the ability to intensify weak detail... step up contrast... drop out stains, creases. And they pass on this improved quality to the final prints.

If you have a blueprint or direct-process machine or vacuum frame

You can produce *positive photographic intermediates directly* from your engineering drawings by reproducing them on any one of four types of Kodagraph *Autopositive* Materials. To do the job—simply expose in your present equipment... and process in standard photographic solutions. No negative step. No darkroom handling—a fast, convenient room-light operation all the way.

1. **Kodagraph Autopositive Paper Extra Thin**—the all-purpose intermediate material for everyday use—gives you intermediates on a durable, white paper base. *Intermediates* which will turn out crisp, clean blueprints and direct-process prints time after time... which will retain their line density and sharpness... and which will remain *photo-lasting* in the files.

2. **Kodagraph Autopositive Paper Translucent...** has an exceptionally durable and translucent paper base... and a print-back speed which is 30% faster than regular Autopositive—*an important advantage in large-volume print production.*

3. **Kodagraph Autopositive Film**—with its highly translucent Kodak safety film base—is especially valuable in reclaiming "hopelessly poor" tracings... and in reproducing extremely fine line detail. It is also widely used to reproduce catalog pages, etc., including half-tone illustrations.

4. **Kodagraph Autopositive Cloth**—is recommended for producing the most durable prints (nearly exact in scale) from drawings in good condition. Its base is white fabric—tough, crease-resistant, highly translucent.

Kodagraph Repro-Negative Paper, which is processed in the same manner as the Autopositive Materials and with the same speed and convenience, enables you to produce positive intermediates directly from blueprints, Van Dykes, and other negative "originals."

If you have any type of contact photocopying machine, you can get negative and positive reproductions of improved quality at lower cost with *Kodagraph Contact Paper*. Its high-contrast photographic emulsion produces photocopies which are easier to read . . . with dense photographic blacks, clean whites. And its extremely wide latitude and amazing uniformity end the need for split-second timing and trial-and-error testing.

Kodagraph Contact Cloth, with an extremely durable, translucent base and with similar emulsion characteristics, is widely used to produce long-lasting second originals from paper negatives. (Unwanted design detail on these negatives can be blocked out before printing.)

If you have an enlarger, projection printer, or process camera, Kodagraph Projection Papers will give you sharp, clean reproductions at any scale – dense photographic blacks, sparkling whites on a durable, Kodak-made paper base. Just the papers you need for reproducing your microfilm and other reduced-scale negatives!

Kodagraph Projection Paper can be printed at high speeds and processed under comparatively bright workroom light. *Kodagraph Fast Projection Paper* can be printed at highest speeds but must be processed under low illumination. *Kodagraph Projection Cloth* is the ideal material for producing extremely durable and fast-printing positive intermediates from reduced-scale negatives.

Increase protection . . . save 98% in filing space with Kodagraph Micro-File equipment. The advantages of modern microfilming are yours *at surprisingly low cost* with Kodagraph Micro-File equipment.

Whether your engineering department be large or small, you will find a precision-built, economical microfilming unit just right for your requirements. One that will record your valuable drawings with photographic accuracy and completeness on *Kodagraph Micro-File Film*—instantaneously . . . for a few cents apiece.

Kodagraph Film Readers give you fast, convenient reference . . . with 100% legibility. *And the Kodagraph Enlarger* allows you to produce facsimile prints in the desired size quickly and economically from your microfilm negatives. *A complete line*—developed and manufactured by Kodak for the utmost precision, convenience, and economy in your microfilming

Kodagraph Reproduction Materials and Equipment

For short cuts, savings, protection . . . in drafting and engineering

Write today for a free copy of "Modern Drawing and Document Reproduction." It gives complete details on the revolutionary line of Kodagraph Reproduction Materials, which you, or your local blueprinter, can process *conveniently, economically.* Also many important facts on Kodagraph Micro-File equipment.

MAIL COUPON FOR FREE BOOKLET

16

EASTMAN KODAK COMPANY
Industrial Photographic Division, Rochester 4, N. Y.

Gentlemen: Please send me a copy of your illustrated booklet giving the facts on Kodagraph Reproduction Products.

Name_____ Position_____

Company_____

Street_____

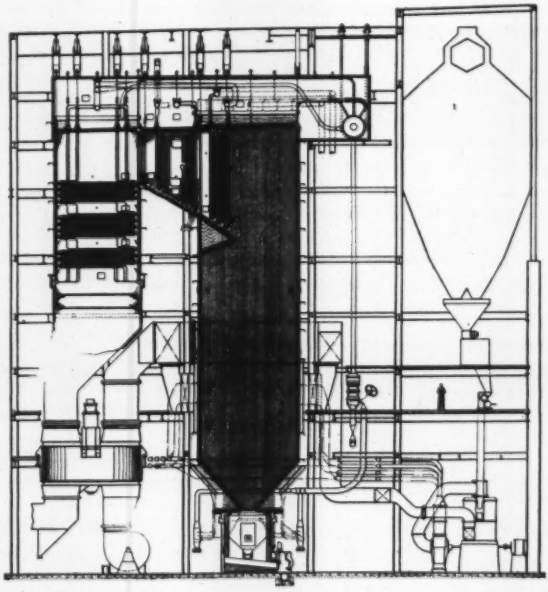
City_____ Zone_____ State_____

Kodak
TRADE-MARK

EASTLAKE PLANT

The Cleveland Electric Illuminating Company

C-E controlled circulation boilers



The C-E Unit shown above is one of three duplicates now in process of fabrication for the Eastlake Plant of The Cleveland Electric Illuminating Company of Cleveland, Ohio.

Each of the three units is designed to serve a 125,000 kw turbine-generator operating at a throttle pressure of 1800 psi with a primary steam temperature of 1050 F, reheated to 1000 F.

These units are of the controlled-circulation, radiant type with a reheater section located between the primary and secondary superheater surfaces. An economizer section follows the rear superheater section and regenerative type air heaters follow the economizer surface.

Pulverized coal firing is employed, using bowl mills and tilting, tangential burners.

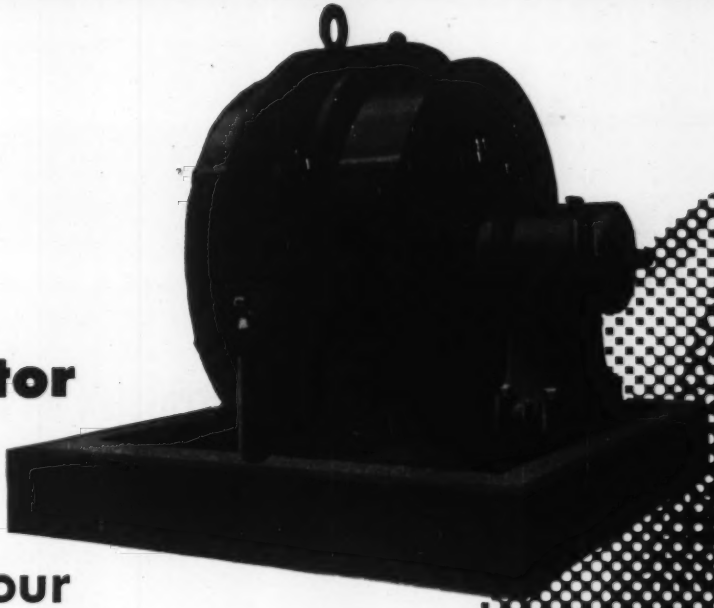
C-E

COMBUSTION ENGINEERING—SUPERHEATER, INC.

200 Madison Avenue, New York 16, N. Y.

B-578

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS



this factor figures in your future

Whatever your drive problems, the motor with the Fairbanks-Morse Seal can be an important factor in the future success of your motor-driven equipment.

For example, when you need synchronous machinery, look for the F-M Seal—as have users of over 5,000,000 horsepower of this type of equipment. That Seal is your assurance of pioneered improvements, proved design, quality manufacture and top performance—factors to figure in your future.

When you look for electric motors, look for the Fairbanks-Morse seal. For over 120 years it has stood for the finest in manufacturing integrity—to *all* industry. Fairbanks, Morse & Co., Chicago 5, Illinois.

FAIRBANKS-MORSE

a name worth remembering when you want the best

ELECTRIC MOTORS AND GENERATORS • MAGNETOS • FARM MACHINERY
DIESEL LOCOMOTIVES AND ENGINES • PUMPS • SCALES
HOME WATER SERVICE EQUIPMENT • RAIL CARS

Just Published . . . . . An authoritative reference on a decade's developements in the mechanism of heat transfer and in the design of apparatus relating thereto.

GENERAL DISCUSSION ON HEAT TRANSFER

Factors . . . . . that paved the way for this Discussion were: The increasing importance of heat transfer with higher-speed aircraft and higher performance of equipment in industry, and the need for a comprehensive review of developments and the applications of known principles.

Sponsors . . . . . of this international forum were: The Institution of Mechanical Engineers and The American Society of Mechanical Engineers with the co-operation of forty-eight other engineering associations.

Results . . . . . The pooled experience of over 150 leading authorities of twelve countries, in ninety-three expertly-written and well-illustrated contributions, the critical summaries of the papers, the detailed accounts of the discussions, the hundreds of bibliographic references, and the fund of hereto unpublished information.

Available . . . . . for the first time, in one volume to designers, engineers, and everyone interested in the new fundamental discoveries in the field and modern methods of approach to heat transfer problems.

Comprehensive
GENERAL DISCUSSION ON HEAT TRANSFER
covers:

- Heat transfer with change of state
- Heat transfer between fluids and surfaces
- Conduction in solids and fluids
- Radiation, instrumentation, measurement techniques, and analogies
- Special problems such as heat transfer in turbine blade cooling, in liquid metals, in gas turbines, and in piston engines, mercury boilers, etc.

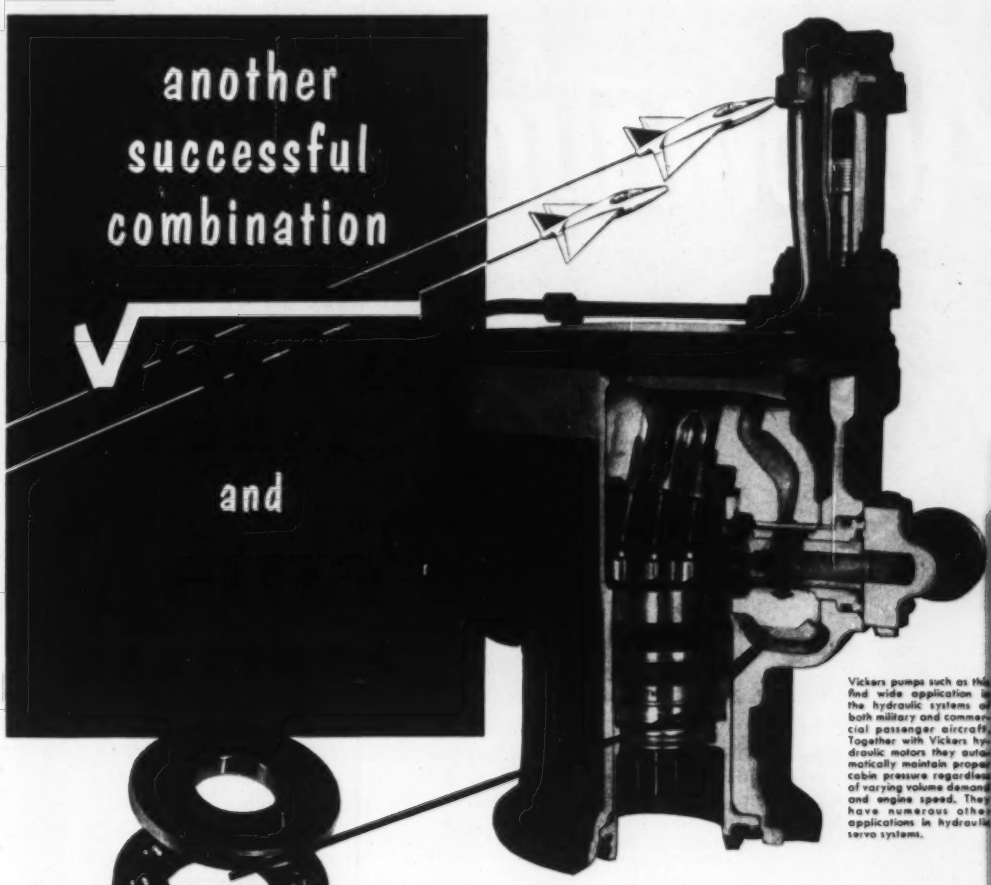
1952 — 500 Pages — 8½″ x 11″ — $10.00

OBTAINABLE in the U.S.A. from

The American Society of Mechanical Engineers

29 West 39th Street **New York 18, N. Y.**

another successful combination



and

Vickers pumps such as this find wide application in the hydraulic systems of both military and commercial passenger aircraft. Together with Vickers hydraulic motors they automatically maintain proper cabin pressure regardless of varying volume demand and engine speed. They have numerous other applications in hydraulic servo systems.

Standard and Special Ball Thrust Bearings • Angular Contact Ball Bearings • Special Roller Bearings • Ball Retainers • Hardened and Ground Washers • Sleeves • Bushings

PUMPS made by Vickers, Incorporated, of Detroit, Michigan, are serving with utmost reliability today in one of the most grueling applications found anywhere in modern aircraft—the hydraulic system.

This enviable record for dependability started when Vickers, to solve a nagging anti-friction problem, switched to Aetna bearings. With every other aspect of the Vickers pump perfected and thoroughly service proven, the addition of Aetna bearings completed the picture. Today, Vickers hydraulic pumps are earning new laurels for performance with an ever-widening number of aircraft makers. For example, one major airline using Vickers-equipped planes, flew 304,578 supercharger pump hours during 1951 *without a single bearing failure.*

Solving difficult bearing problems to help make good products better has been one of Aetna's most intensified engineering activities for 36 years. Why not call on Aetna the next time YOU have a problem involving bearings or precision parts?

AETNA BALL AND ROLLER BEARING COMPANY

4600 Schubert Avenue • Chicago 39, Illinois

Automatic Control

- Permutit motor operated valves make regeneration of the Mixed Bed Demineralizer completely automatic. This gives more positive control . . . eliminates the dangers of costly human errors—and takes less time . . . saves man-hours formerly spent in regeneration. In a recent installation for a 1450 psi boiler, two compact Permutit Mixed Bed units fill all make-up requirements . . . supply demineralized, silica-free water continuously and automatically—even if one unit is out of service. What better way to eliminate boiler scale and silica deposits on turbine blades!

MINERAL IMPURITIES REACH VANISHING POINT

An almost infinite number of separate ion exchange steps take place simultaneously in the homogenous mixture of anion and cation exchangers. Result—mineral content so low that conventional water analysis methods cannot determine the minute quantities remaining. The effluent of a Permutit Mixed Bed Demineralizer has contained *total* electrolytes of less than 0.1 ppm . . . and silica below 0.01 ppm! (Most commercial distilled water contains 10 to 50 times more electrolytes . . . costs much more to produce.)

TWO AMAZING RESINS DO THE JOB

Highly efficient Permutit Q and Permutit S do the whole job under positive automatic control in the Mixed Bed Demineralizer. Permutit Q is a high capacity hydrogen cation exchange resin that is extremely resistant to wide pH ranges, high temperatures, and oxidizing conditions. Permutit S, a strongly basic resin with a high reaction rate, reduces silica to a range far lower than previous methods.

New Booklet—DEMINERALIZATION BY ION EXCHANGE

This interesting new bulletin describes the key methods of demineralizing water and removing silica by ion exchange.

For your copy, write to: The Permutit Company, Department ME-11, 330 West 42nd Street, New York 36, N. Y. or the Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

PERMUTIT

ION EXCHANGE AND WATER CONDITIONING HEADQUARTERS

Detroit RotoGrate Stoker's ability to burn wartime coal Brought Repeat Order—

Municipal Plant, Wyandotte, Michigan

Wyandotte, Michigan Municipal Power Plant, C. F. Bufe, Superintendent, Ira Singles, Chief Operator.
Emery, Markar and Emery, Toledo, Ohio, Consulting Engineers.

In 1942, the Municipal Plant, Wyandotte, Michigan had coal trouble, as did most plants with old type firing equipment. It became almost impossible to operate on the coal they could get.

They purchased a Detroit RotoGrate, which solved their fuel problem immediately. The RotoGrate proved able to burn efficiently any coal available including the poor stuff which war conditions often forced them to use. In the fall of 1951 when they expanded the plant the Detroit RotoGrate was again the stoker chosen.

Detroit RotoGrate is a modern type spreader stoker with grates that move slowly forward, discharging ash at the front. A RotoGrate installation makes it possible to buy the most economical coal, and burn it with highest economy.

Write for Bulletin.

DETROIT STOKER COMPANY

General Motors Bldg. • Detroit 2, Michigan

WORKS AT MONROE, MICH. • District Offices in Principal Cities

Are You

The chain habit is a good one to have when you're designing drives and conveyors. But *don't* be "chained" to just one particular type of chain. In the complete Chain Belt line there are literally hundreds of sizes and types of chain, each one designed to do a specific kind of work. Naturally, you want to select the chain that will perform most efficiently and economically over the longest period of time.

There's where your Chain Belt Field Sales Engineer can help you. You see, he is specially trained to study with you your chain selection problems. He can recommend from the complete Chain Belt line the one chain which will give the most satisfactory service in your

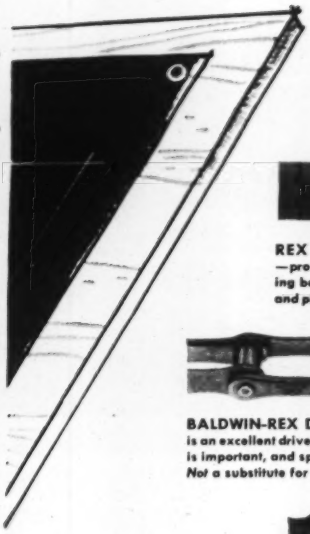
REX

BALDWIN-REX®

Chain

ATLANTA • BIRMINGHAM • BOSTON • BUFFALO
CHICAGO • CINCINNATI • CLEVELAND • DALLAS
DENVER • DETROIT • EL PASO • HOUSTON
INDIANAPOLIS • JACKSONVILLE • KANSAS CITY
LOS ANGELES • LOUISVILLE

"CHAINED" By Habit?



REX® CAST PINTLE CHAIN—for slower speed drive and conveyor service where long life due to greater bearing area is needed.

REX TABLETOP® CONVEYOR CHAIN—provides a smooth, steady surface for conveying bottles, jars, cans, etc. Simple, two-piece link and pin construction makes for easy maintenance.

BALDWIN-REX DOUBLE PITCH ROLLER CHAIN is an excellent drive or conveyor chain where light weight is important, and speeds and loads are low to moderate. *Not* a substitute for standard roller chain.

BALDWIN-REX® STANDARD ROLLER CHAIN—ideal for high speed drives and timing applications. A wide range of attachments is available for every type of conveyor service.

BALDWIN-REX LEAF CHAIN—an excellent chain for tension linkage applications where linear movement of the chain is not continuous in direction. Used on lift trucks, hoists, controls, etc.

REX CHABELCO® STEEL CHAIN—especially suited for operation where loads are heavy and conditions of dust, dirt, and grit are encountered. This chain can really take it!

application. Illustrated here are just a few samples from our complete line. They are all quality chains built with over 60 years of chain-making experience behind them.

Next time you have a chain selection problem, why not call your nearest Chain Belt branch office; or if you prefer, just mail the coupon. Chain Belt Company, 4765 W. Greenfield Ave., Milwaukee 1, Wis.

Belt COMPANY
OF MILWAUKEE

MIDLAND, TEXAS • MILWAUKEE • MINNEAPOLIS
NEW YORK • PHILADELPHIA • PITTSBURGH
PORTLAND, OREGON • SPRINGFIELD, MASS.
ST. LOUIS • SALT LAKE CITY • SAN FRANCISCO
SEATTLE • TULSA • WORCESTER

Chain Belt Company, 4765 W. Greenfield Avenue 52-104
Milwaukee 1, Wis.
Gentlemen:
I am particularly interested in chains for the following purposes

.....

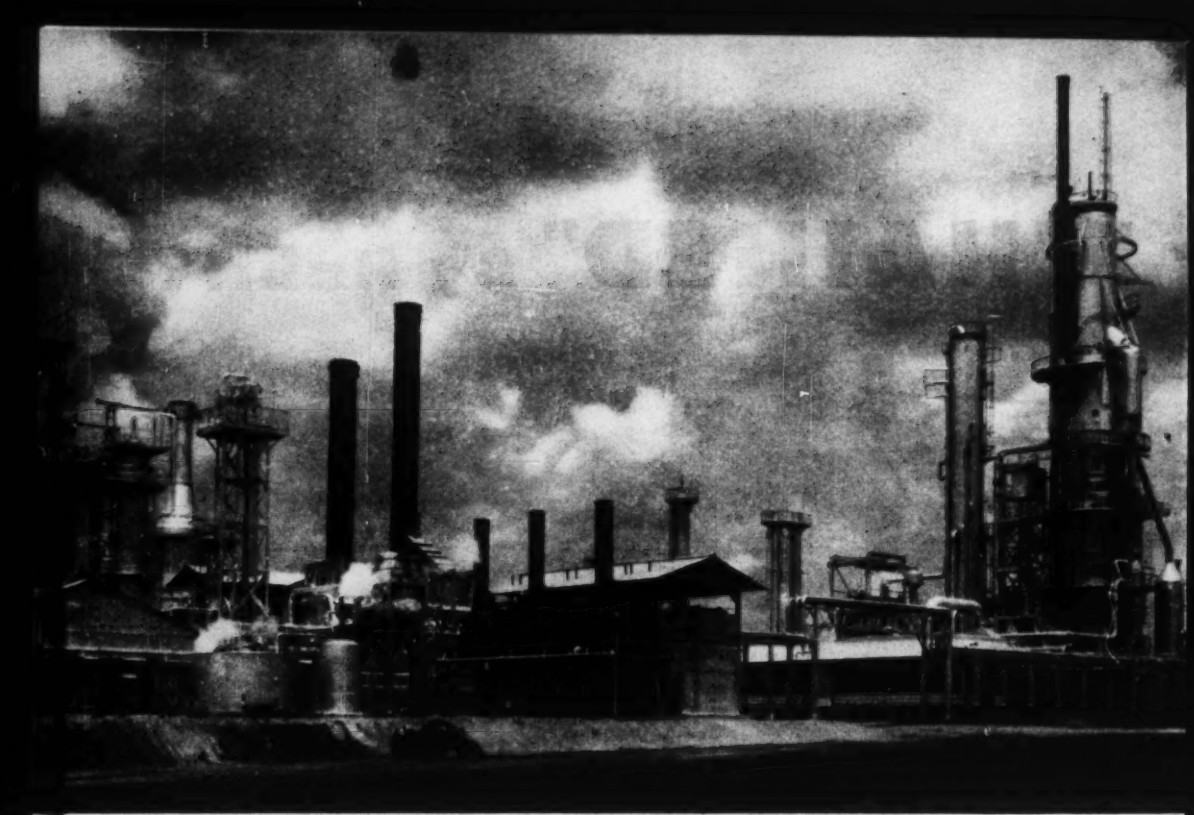
.....

Please send me appropriate literature.

Name.....

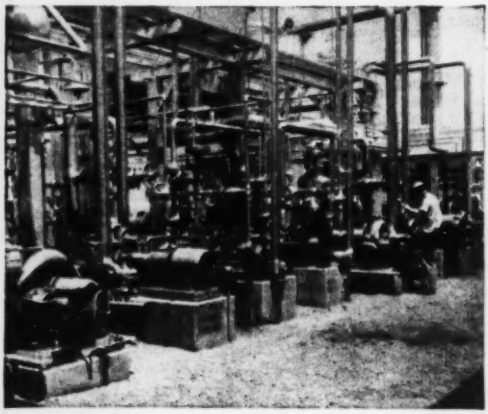
Address.....

City..... *State*.....

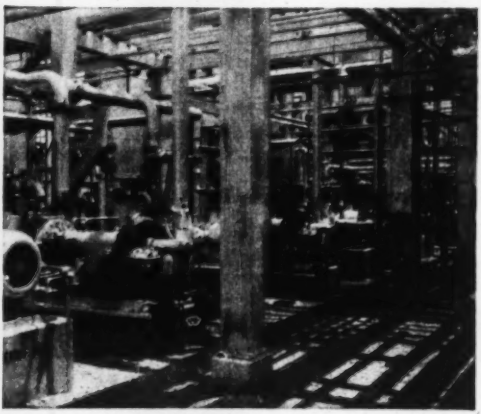


McMurrey Refining Company, Tyler, Texas, installed G-E mechanical-drive turbines throughout their plant to help assure continuous capacity output of 5000 bbls. per day.

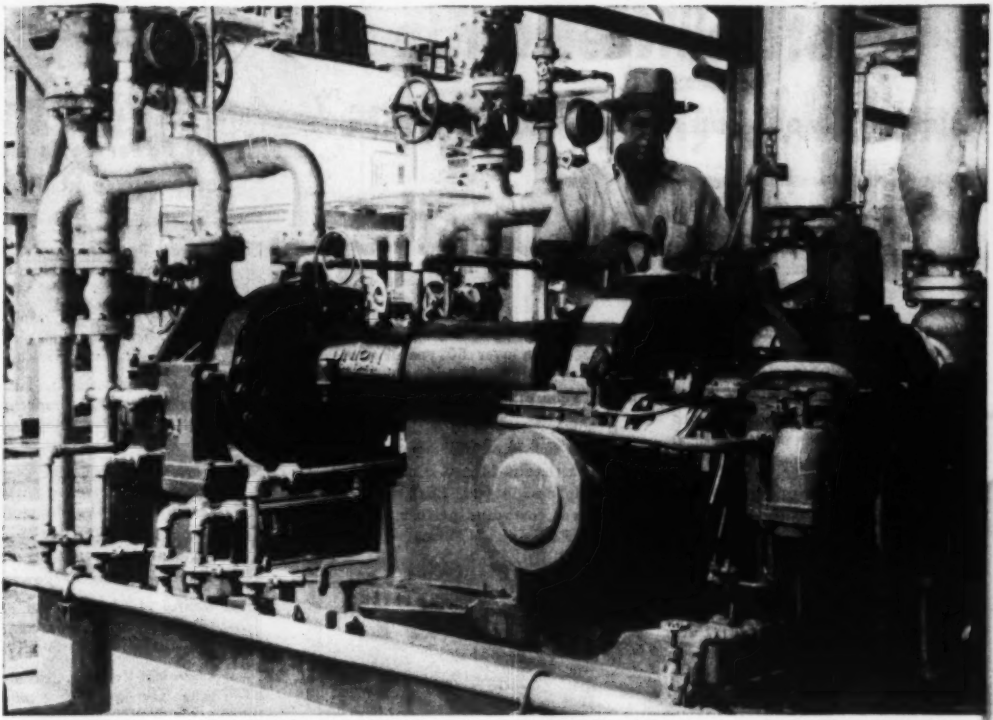
G-E Turbines Save Maintenance,



G-E turbines and motors are paired at McMurrey Refinery to utilize large steam supply efficiently. When process steam demands decrease, surplus steam is economically diverted to turbine drives. These Type DP turbines range from 8 hp to 41 hp.



Shown here is part of a row of ten General Electric Type DP turbine drives and motors, ranging from 9 hp to 48 hp. The many interchangeable parts on these turbines make stocking of spare parts an economical matter.



Maintenance personnel at the refinery have found this General Electric Type DP mechanical-drive turbine, like the many others at the refinery, easy to maintain. This 47-hp turbine at McMurrey Refinery drives a boiler-feed water pump.

Inventory Costs at McMurrey Refinery

Installed to improve steam balance, G-E standard turbines, with many interchangeable parts, also cut inventory costs.

The McMurrey Refinery, Tyler, Texas, installed General Electric mechanical-drive turbines to help regulate steam balance. Since process steam demands range from 30% to 70% of available supply, surplus steam is economically diverted to turbine drives.

Time soon proved that General Electric turbine drives have many other advantages. Mr. Dave Hood, Mechanical Maintenance Foreman at the refinery, states, "With these turbines on the line now for over a year, we're happy to report that they are extremely easy and economical to maintain, requiring very little of our time for maintenance."

Mr. Hood also said, "Since we have quite a few different sizes and ratings of turbines here, we're particularly pleased with the great number of interchangeable parts on these turbines. It certainly cuts down our inventory problem." Interchangeability of a great majority of the replaceable parts (regardless of hp rating) is a big feature with G-E standard turbine drives, which are paired with motors throughout the refinery to help assure uninterrupted service.

Call in your G-E sales-engineer or write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." Section 252-59, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

FAIRBANKS-MORSE DIESELS CAN ELIMINATE YOUR

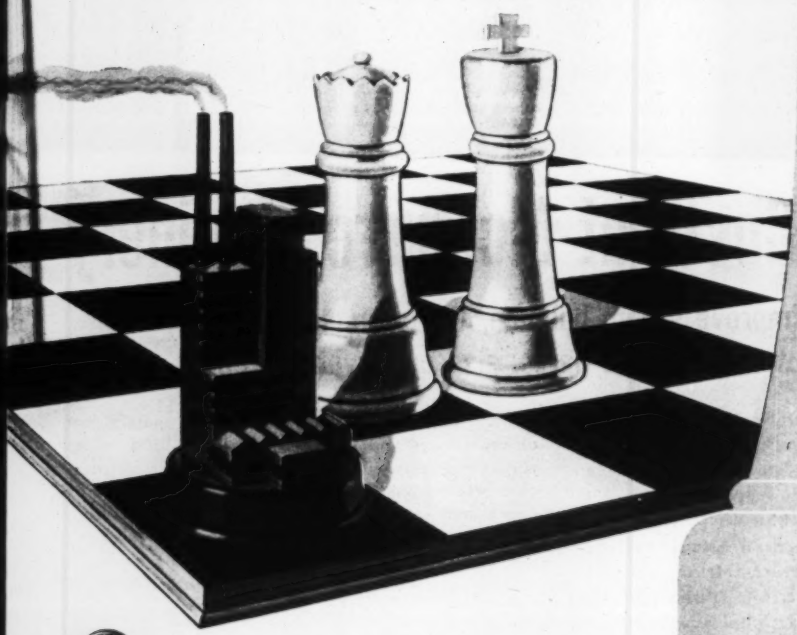
Power Checkmate

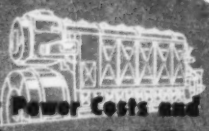
Poor power factor, adverse current characteristics, surge loads . . . any one of these conditions can put your plant in a power checkmate. You are then paying a penalty that can mean the difference between profit and loss.

What's the Next Move in *Your* Plant?

Look at your power problem. Then look at this representative list of advantages brought to you by Fairbanks-Morse Diesel power generation. These are *proved* answers to your problem . . . based on over 50 years' experience in industrial and municipal power generation.

If power has you in a checkmate, write us today, outlining your problem. Fairbanks-Morse Engineering can help decide your next move to put power costs and performance in order. Fairbanks, Morse & Co., Chicago 5, Ill.





Put Your Power Costs and Performance in Order

1 ***Handle Peak Demand*** . . . reduce peak demand values for lower purchased power rates.

2 ***Power Factor*** . . . in-plant power generator can eliminate power factor penalties.

3 ***Emergency Power*** . . . insurance against lost production and damage resulting from line failures.

4 ***Handle Surge Loads*** . . . that may now be affecting current characteristics of entire plant.

5 ***Plant Expansion*** . . . need not be restricted due to lack—or expense—of ample power.

6 ***Useful Heat*** . . . lube oil, water and exhaust heat can be turned from waste to profit.

7 ***Chemical Value*** . . . exhaust gases are high in free nitrogen—available for economical fixation of nitrates, ammonia, etc.

8 ***Insurance Advantage*** . . . of diesel over gasoline engine, for example, will soon pay for installation.

9 ***No Weather Worries*** . . . ice, snow, sleet, wind storms can't stop plant operations.

10 ***Handle Increasing Load*** . . . in-plant power economically adds to current capacity as loads increase.

11 ***Fuel Economy*** . . . use diesel oil, natural gas or sewage gas for added economy.

12 ***Remote Locations*** . . . distance from transmission lines needn't curtail plant expansion.

13 ***More Compact Power*** . . . Fairbanks-Morse engines give you more power per foot of floor space, more power on present foundation.

14 ***Minimum Attendance*** . . . Fairbanks-Morse in-plant generating sets require far less supervision or maintenance.

15 ***Save Cost*** . . . of running in new line where present transformers and power lines are already loaded.

FAIRBANKS-MORSE,

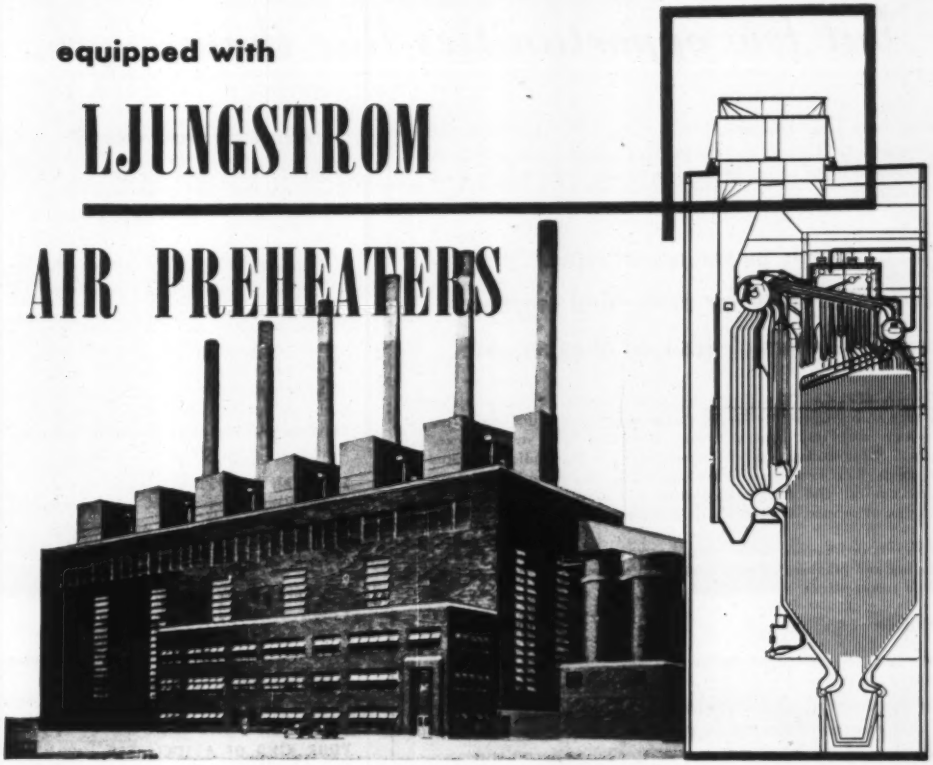
a name worth remembering

DIESEL AND DUAL FUEL ENGINES • DIESEL LOCOMOTIVES • ELECTRICAL MACHINERY • PUMPS • SCALES • RAIL CARS • MAGNETOS • FARM-MACHINERY

Three Boilers at Noblesville Station of the Public Service Company of Indiana

equipped with

LJUNGSTROM AIR PREHEATERS



Public Service Company of Indiana, in its post-war expansion program, has added hundreds of thousands of kilowatts for the increasing needs of rural and industrial midwest.

The latest new station to go on the line is Noblesville Station, designed by Sargent & Lundy, Chicago, to add 90,000 KW to this utility's power output. Noblesville utilizes three Riley Steam Generating Units. Each unit is pulverized coal fired, with a capacity of 300,000 lb of steam per hr at 1025 psi and 950 F.

Each Riley unit is supplied with a Ljungstrom Air Preheater, which preheats combustion air to 650 F, cools exit gas to 288 F before it enters the stack.

The unanimity with which Ljungstrom Air Preheaters are chosen for high efficiency steam generating units like these is the best evidence of their high thermal efficiency and dependability. Every boiler manufacturer has included Ljungstrom Air Preheaters in outstanding installations made during the past few years.

THE Air Preheater Corporation

60 E. 42nd St., New York 17, N. Y.

There are hundreds of jobs open to engineers today!

but few opportunities like these

Westinghouse is in nuclear power to stay. We believe in the development of atomic energy as man's next great source of power. If you want to get in on a new era in industry, we want to talk to you.

Atomic power opportunities are waiting now for mechanical engineers with 4 to 10 years of this kind of experience...

DESIGN OR APPLICATION—light and heavy structural supports for machinery... high pressure piping and systems... rotating machinery ... steam turbines, general steam apparatus and steam power systems... heat exchangers and condensers ... hydraulic apparatus and systems, fluid flow, systems evaluations, heat balance, valve design ... mechanical and hydraulic devices and mechanisms (thorough knowledge of properties of materials required).

LIAISON—coordination with subcontractors and customers ... scheduling and planning of ship trials and customer testing of nuclear powered steam plants.

SUPERVISION of drafting work.

REMEMBER! We are primarily interested in good *experienced* application and development engineers—lack of previous reactor development experience *is no handicap in this type of work.*

HOW TO APPLY! What Westinghouse wants to know is: Where and when you obtained your degree ... how you did in school ... where you have worked at your profession ... what kind of work you have done.

In other words, right now we're more interested in your ability to fill current openings and to develop in the Westinghouse Atomic Power Division than we are in your vital statistics. Write your letter of application accordingly.

You will be in communication with men who are experienced in keeping secrets. All negotiations will be discreet, and your reply will be kept strictly confidential.

Address your application letter to: Manager, Industrial Relations Department, Westinghouse Electric Corporation, P. O. Box 1468, Pittsburgh 30, Pennsylvania.

What do you want?

MONEY? Good jobs are open here now—waiting for good men who want to make a permanent connection.

A PERMANENT JOB? Many of the engineers who joined Westinghouse 20 and 25 years ago are still with Westinghouse—and in key positions—and engineers who join us now will have the opportunity to make this work their lifetime careers. When many other industries may be going through slack times, atomic energy will still be in a stage of expansion.

SUBURBAN LIVING? It's here—within easy driving distance of your work. Within a few minutes of shopping centers ... schools ... metropolitan centers.

JOB EXTRAS? Westinghouse offers: Low cost life, sickness and accident insurance with hospital and surgical benefits. A *modern* pension plan. Westinghouse stock at favorable prices. Westinghouse appliances for your home at discount.

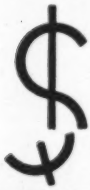
YOUR KIND OF ASSOCIATES? Every fourth person in the Division is an engineer or scientist. More than half the top Westinghouse executives are engineers.

FASCINATING WORK? What other branch of science offers such exciting challenges? So many opportunities for discovery? So many chances to benefit mankind? So many opportunities for original work?

GROWTH OPPORTUNITIES? Never again in your lifetime will you be able to get into such a sure-to-expand industry so early in its development.

YOU CAN BE SURE.. IF IT'S Westinghouse

HOW 40 COMPANIES
cut gear costs



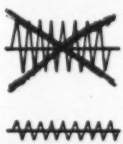
Of 50 companies checked in 23 industries, 40 told us that they adopted Cone-Drive Gears or reducers because they reduced overall costs of their products. Included are companies making conveyors; cranes, hoists and winches; machine tools; mixers, and agitators; and equipment used for agriculture, baking, chemicals, construction, food processing, foundry, laundry, leather, materials handling, mining, paper, power, rubber, steel, textiles and welding.

HOW 42 COMPANIES
cut gear size and weight

An even larger number picked Cone-Drive gears and reducers because of the savings in size and weight which they made possible. Among these were companies producing:

Aircraft
Bakery Equipment
Chemical Equipment
Construction Machinery
Conveyors
Cranes, Hoists, Winches
Food Processing Machinery
Foundry Equipment
Leather Machinery
Lumber Machinery
Machine Tools
Materials Handling
Mining Equipment
Mixers and Agitators
Paper Machinery
Plastics Machinery
Rubber Machinery
Steel Mill Equipment
Textile Machinery
Welding Equipment

HOW 17 COMPANIES
cut vibration



Since there are more teeth in contact in Cone-Drive gearing, their 'hydraulic' smoothness was a major factor in their adoption by manufacturers of: aircraft; agricultural equipment; chemical equipment; laundry equipment; machine tools; materials handling equipment; mixers and agitators; rubber machinery; steel mill equipment; textile machinery and welding equipment.

HOW 11 COMPANIES
cut no. of gears needed

The ability of Cone-Drive gears to handle large reductions efficiently on small center distances has enabled many companies to reduce the number of gears needed in their products. Among those who checked this as a major reason for specifying Cone-Drive gears and reducers were manufacturers of:

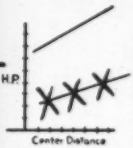
Aircraft
Chemical Equipment
Machine Tools
Materials Handling
Mining Equipment
Mixers and Agitators
Steel Mill Machinery
Textile Machinery

HOW 31 COMPANIES
boosted gear life

Cone-Drive double-enveloping gears give longer life because they distribute the load over more teeth and have a larger contact area per tooth. For the same reason maintenance requirements are also sharply reduced. Industries in which companies checked this item as a major factor in the adoption of Cone-Drive gears and reducers include:

Aircraft
Agricultural Equipment
Bakery Machinery
Chemical Equipment
Conveyors
Cranes, Hoists, Winches
Dams
Food Processing Equipment
Foundry Equipment
Leather Machinery
Lumber Machinery
Machine Tools
Materials Handling
Mining Equipment
Mixers and Agitators
Paper Machinery
Plastics Machinery
Rubber Machinery
Steel Industry
Textile Machinery
Welding Machines

HOW 42 COMPANIES
increased gear loads



The ability to increase load capacity for the same gear size—or even while REDUCING gear size—when Cone-Drive gearing is used, was a major factor in the adoption of these gears in practically every industry in which companies were checked.

Cone-Drive gears and reducers derive their advantages primarily from the fact that the gears and worms are double-enveloping. This means greater contact per tooth, more teeth in contact, better load distribution, increased capacity, longer life, lighter weight, smoother operation, higher safety factor, ability to resist shock loads, freedom from service trouble—and LOWER OVER-ALL COST.

If you would like to see the check list covering these companies, ask for Bulletin No. 101-C-222-R.

CONE-DRIVE GEARS
Division Michigan Tool Company
DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS
7171 E. McNichols Road • Detroit 12, Michigan

STUDENT MEMBERS

OF THE ASME

you can get—

A LITTLE CASH!
A LITTLE FUN!
A LITTLE FAME!

HERE'S your opportunity to get that for which you have lacked the wherewithal. There's just one catch — you will have to work for it! If you quit easily — don't read any further. Perhaps a little extra work on your thesis will do the trick.

An engraved certificate signed by the President and Secretary of the Society will accompany each award.

A trip to the Annual Meeting as a guest of the "Old Guard" will be awarded.

Students should consult the Honorary Chairman regarding the rules for these awards. Only papers by single authors will be considered.

Each student must submit his paper to the Vice President of the Region in which his Student Branch is located not later than June 1, 1953

$150.00

For the best paper by an undergraduate on a given subject. When it has been selected it will be sent to the Student Branches. This is the Charles T. Main Award.

An undergraduate must submit his paper for the Charles T. Main Award or Undergraduate Student Award before thirty days after the completion of his undergraduate work.

$25.00

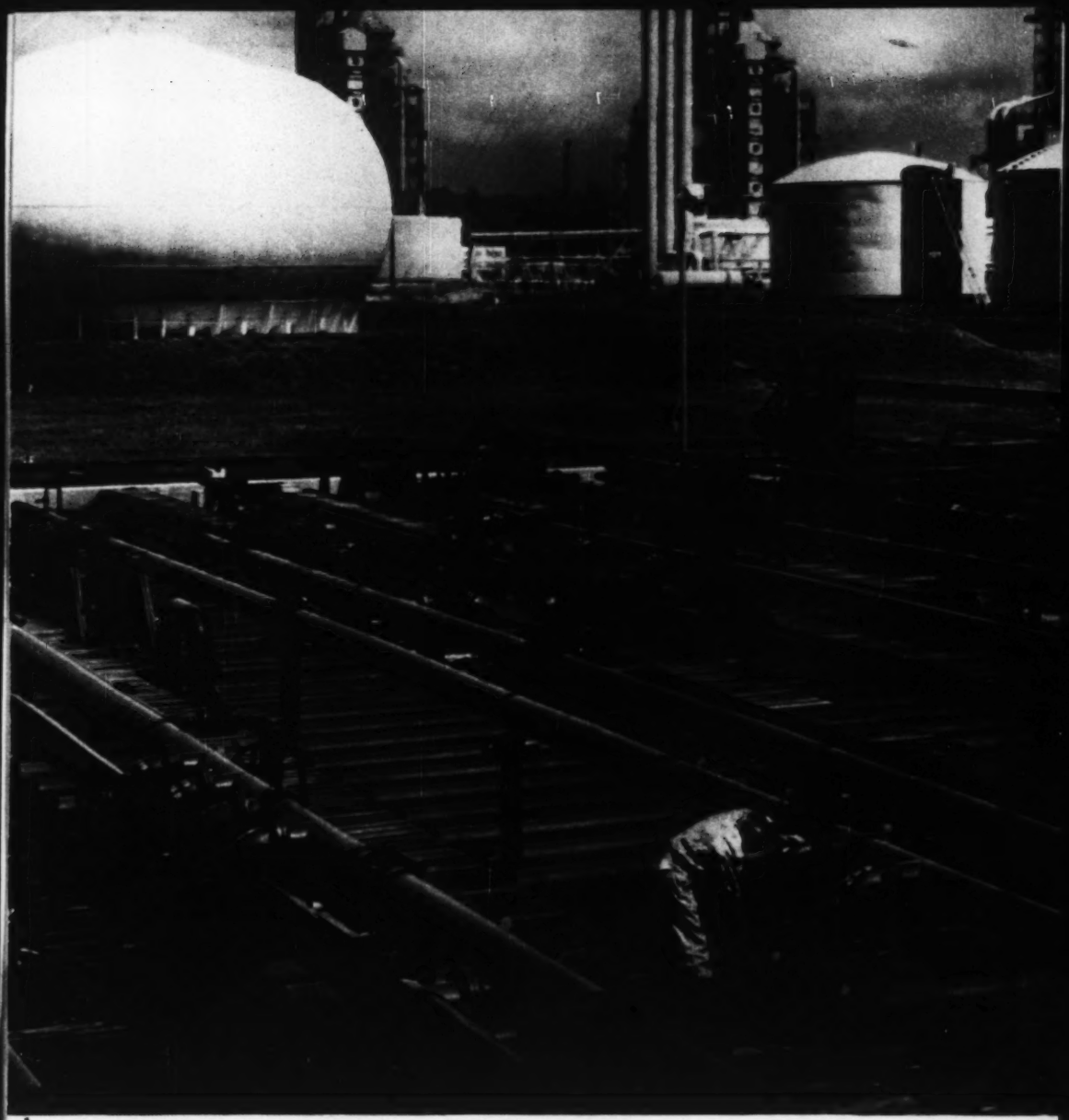
For the best paper on an engineering subject by an undergraduate. This is the Undergraduate Student Award.

$25.00

For the best paper on an engineering subject by a graduate student. This is the Postgraduate Student Award.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 West 39th St., New York 18, N. Y.



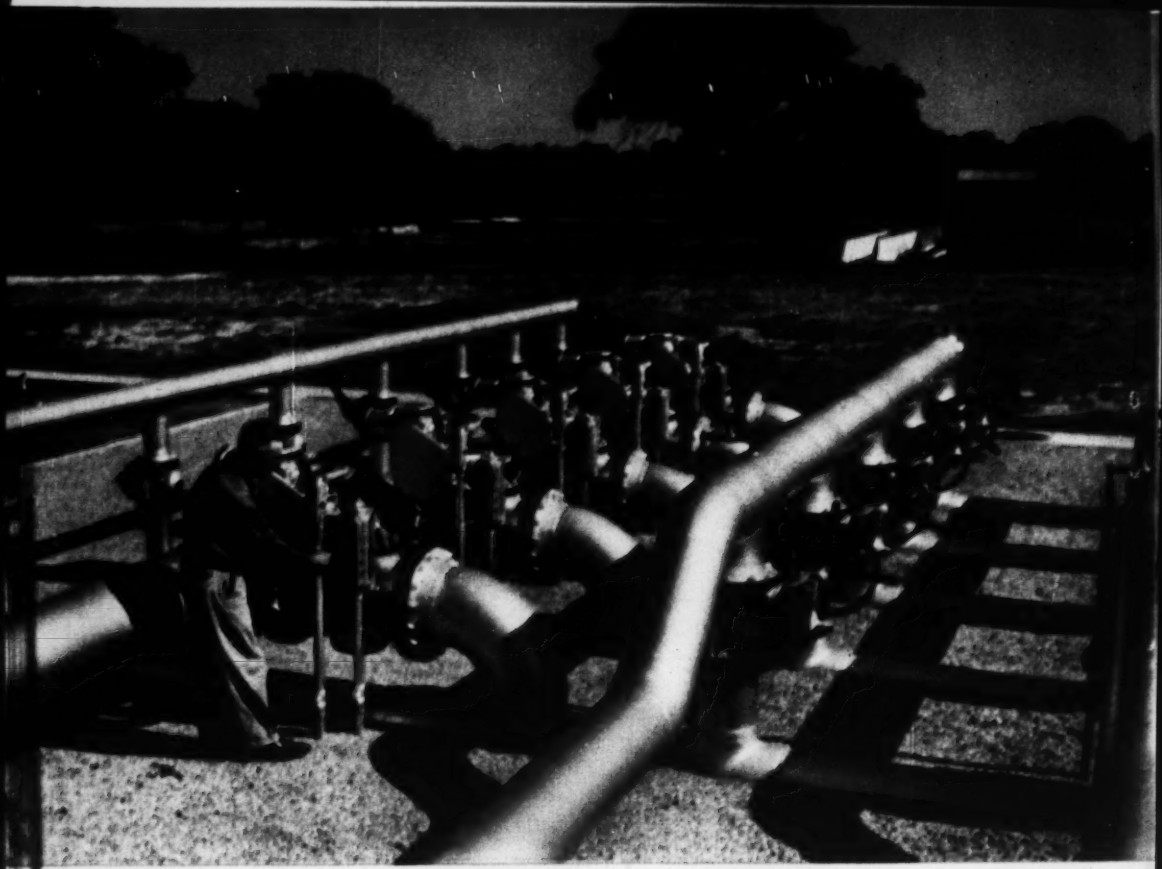
Manifold Control–THE SAFE, SURE NORDSTROM WAY

Often, in a single manifold, Nordstrom valves will be used to control several forms of gas, a variety of petroleum derivatives, or a diversified group of hard-to-hold chemicals.

Because of their versatility . . . because they are available in so many different metals, sizes, pressure classes and styles . . . because they are doubled-sealed with lubricants especially compounded for specific services . . . because they open and close on a quarter-turn—these are among the reasons Nordstroms are ideal for manifold service.

In your control manifolds—consider the advantages of specifying Nordstrom lubricant-sealed valves throughout.

Rockwell Built
Another Rockwell Product
Nordstrom Valves
LUBRICANT SEALED TO KEEP UPKEEP DOWN



How To Save Money On Valves

These installations are illustrations of the best way to save money on valves: specify Nordstroms in the first place. In original cost, Nordstrom valves often cost no more; over the life of the line or the equipment they serve, they almost always cost much less.

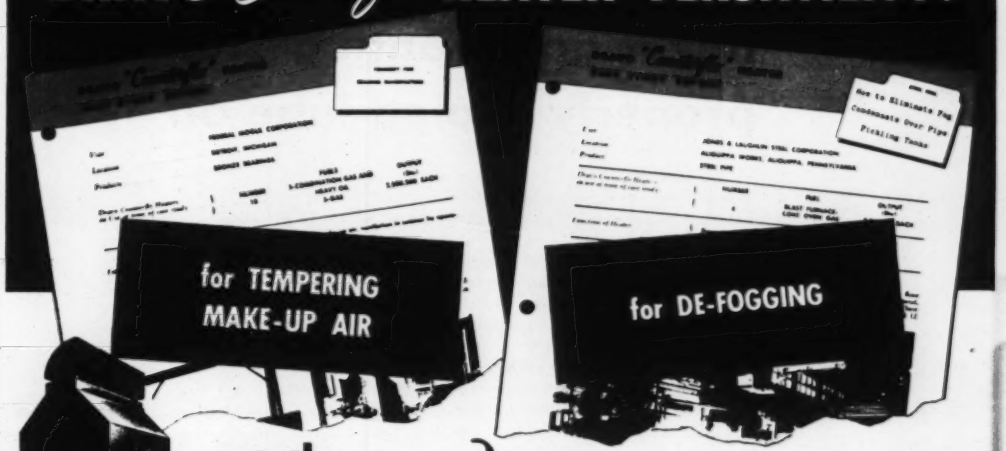
Nordstroms, the original lubricated plug valves, have proved their economy through 30 years of hard service in several thousands of different types of processes in gas, petroleum, chemical and other technological industries. That experience, that performance, is your reference. Nordstrom Valves are built by the Rockwell Manufacturing Company, 400 N. Lexington Ave., Pittsburgh 8, Pa.

Rockwell Another Rockwell Product **Built**
Nordstrom Valves

LUBRICANT SEALED TO KEEP UPKEEP DOWN

HERE'S YOUR PROOF OF . . . .

DRAVO *Counterflo* HEATER VERSATILITY!



get these FREE case studies now!

Detailed information and photographs show how heaters can be adapted for tempering make-up air . . . or how de-fogging of a plant may be accomplished using Dravo Heaters. These case studies give you proof of Dravo Heater versatility, and they're yours for the asking.

DRAVO HEATERS OFFER YOU:

LOW INITIAL COST—Users report 30% to 60% savings over "wet-type" systems.

EASY INSTALLATION—Need only fuel, exhaust and electrical connections . . . no ductwork.

LOW OPERATING COST—Direct-fired . . . burn gas or oil . . . readily converted . . . minimum efficiency 80%.

AUTOMATIC OPERATION—On-off or modulating controls . . . no constant attention needed.

LONG SERVICE LIFE, LOW MAINTENANCE—Stainless steel combustion chamber eliminates refractory lining.

SAFETY—Approved by American Gas Association, listed by Underwriters' Laboratories, Inc.; Dravo standardized safety control circuit accepted by Factory Mutual Engineering Division.

MOBILITY—Can be moved to any location.

FLEXIBILITY—When floor space is limited, can be wall-hung or suspended from trusses in any position.

DRAVO HEATERS SOLVE HEATING PROBLEMS IN THESE INSTALLATIONS, TOO:

- **PROCESS DRYING AND HEAT CURING**—where moisture content must be controlled or removed from air, and temperature regulated to meet production needs.
- **HEATING AND VENTILATING STORES, SCHOOLS, AUDITORIUMS, AND LARGE BUILDING AREAS**—where quick, automatically controlled, low-cost heating is desired.
- **TEMPORARY HEATING**—where comfort heat is necessary during building construction or to keep ground temperature above freezing in winter.

FOR FREE CASE STUDIES OF INTEREST TO YOU

MAIL THIS COUPON TODAY . . .

(Case Study sheets are 8½" x 11", punched for binder or convenient filing.)

HEATING DEPARTMENT, DRAVO CORPORATION
Dravo Building, Fifth and Liberty Avenues
Pittsburgh 22, Pa.

DRAVO

Please send me the following case studies FREE:

- ☐ Process drying and heat curing
- ☐ Space heating large buildings
- ☐ Tempering make-up air
- ☐ Temporary heating
- ☐ Stores, schools and auditoriums
- ☐ Please have a representative call.

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

When writing ask for Bulletin DE-52 -132

DRAVO
CORPORATION

PITTSBURGH • ATLANTA • BOSTON • CHICAGO • CINCINNATI CLEVELAND • DETROIT • NEW YORK • ST. LOUIS • PHILADELPHIA WASHINGTON

Sales Representatives in Principal Cities

Manufactured and sold in Canada by Marine Industries, Ltd., Sorel, Quebec. Export Associates: Lynch, Wilde & Co., Washington 9, D.C.

On this Falk Speed Increaser

gears and bearings never go "wanting" for properly cooled lube oil

For adequate lubrication at most effective oil temperatures, external coolers are frequently furnished with Falk High Speed Gear Units.

The speed increaser shown, which is used in a fuel oil and gasoline pipeline pumping station, is typical. In addition to the integral water-jacket cooler in the cover, this Falk unit, like numerous others, comes equipped with a compact, Ross Type BCF Exchanger. In this way, gears and bearings never go "wanting" for sufficient lubrication at the right temperature.

The durable all-copper and copper alloy construction that spells out l-o-n-g l-i-f-e, and the pre-engineered, fully standardized designs that provide unrivaled benefits in time and cost, have made the Ross Type BCF Exchanger the standard selection of most original equipment manufacturers today.

For your diesels, compressors, turbines or whatever machines you make, the Ross "BCF" is the exchanger you should know all about. Bulletin 1.1K5 gives the major facts. Write.

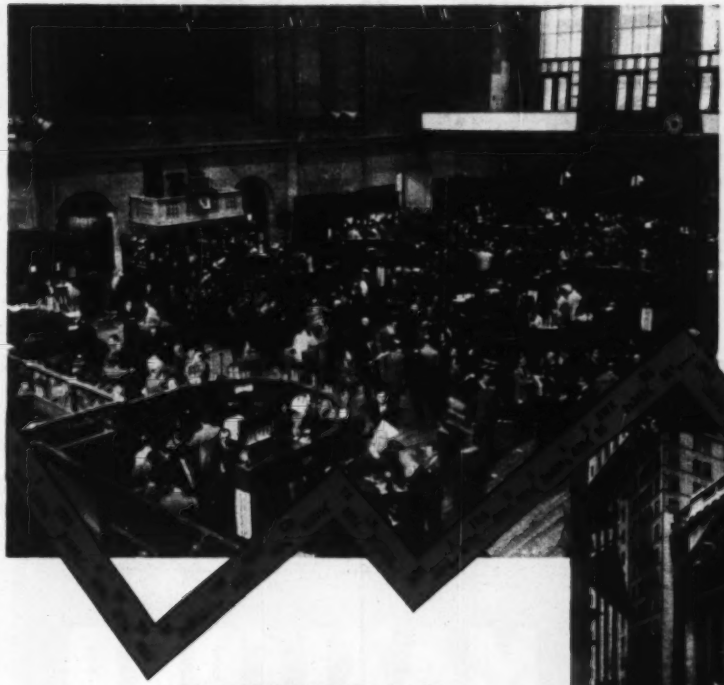
KEWANEE-ROSS CORPORATION
DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION
1448 WEST AVENUE • BUFFALO 13, N. Y.
In Canada, Horton Steel Works, Limited, Fort Erie, Ont.

IT'S ROSS EXCHANGER EQUIPPED

ROSS
EXCHANGERS

KEWANEE-ROSS PRODUCTS

Serving home and industry



NEW YORK STOCK EXCHANGE

The Nation's Largest Securities Market Place

Erected in 1903

Architect: George B. Post
Ventilating Engineer: Alfred R. Wolf
Refrigerating Engineer: Henry Torrance

Consulting Engineer present air conditioning system: Charles S. Leopold

Mr. D. A. Kepler, Chief Engineer, in the photograph above, reports temperature is held within limits of approximately 1° F. plus or minus.

POWERS®

AIR CONDITIONING CONTROL

Used in this World Famous Securities Market

No matter how the "temperature" of the market fluctuates, air conditions on the trading floor of the Stock Exchange remain stable throughout the year.

Back in 1903 the New York Stock Exchange pioneered with the installation of a comfort cooling system which Mr. Donald A. Kepler, Chief Engineer describes as follows:

"It was one of the first systems of its kind applied to a large densely populated market place and by far the largest plant devoted primarily to air cooling and dehumidification. No controls were employed in the cooling season but in winter temperature and humidity were automatically controlled by a pneumatic system.

The air conditioning system now in use, the third since 1903, is modern and reflects the progress of air conditioning during the past 50 years."

Other Prominent Users of Powers Control

Toronto Stock Exchange • Midwest Stock Exchange

When temperature and humidity control problems arise contact Powers nearest office. Our 60 years of experience gained in many important buildings may be helpful to you.

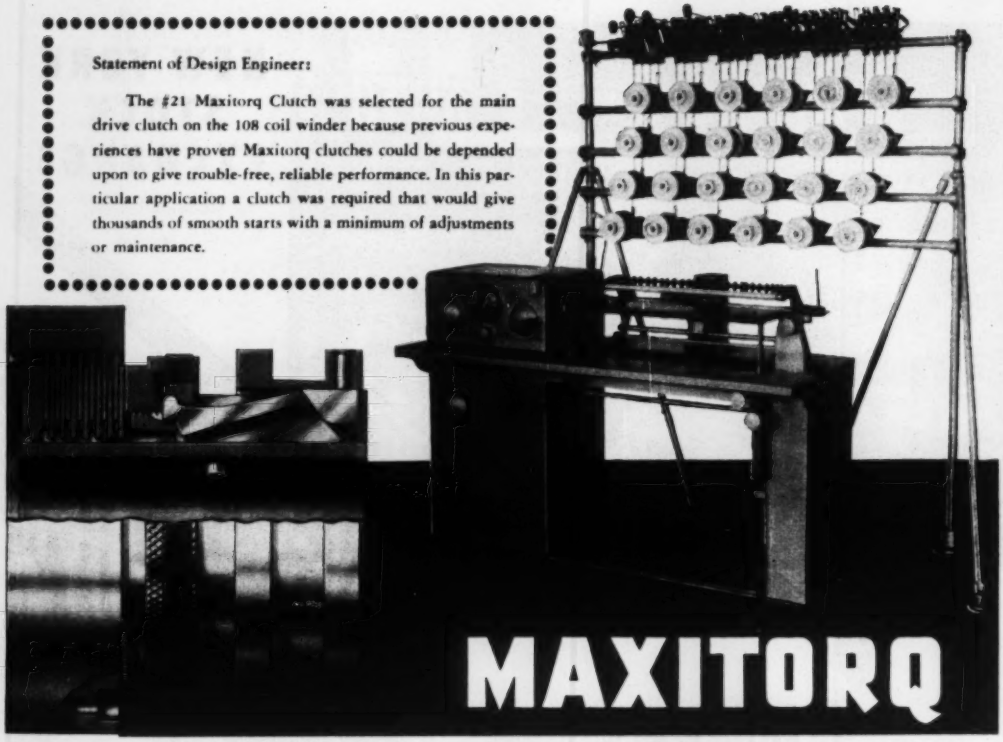
Factory and General Offices: Skokie, Ill.

POWERS CONTROLS

(a94)

Statement of Design Engineer:

The #21 Maxitorq Clutch was selected for the main drive clutch on the 108 coil winder because previous experiences have proven Maxitorq clutches could be depended upon to give trouble-free, reliable performance. In this particular application a clutch was required that would give thousands of smooth starts with a minimum of adjustments or maintenance.



MAXITORQ

KEEPS GOOD COMPANY

The Maxitorq floating disc clutch is making a lot of good friends these days . . . as evidenced by the statement above from Universal Winding Company, Providence, R. I.

Their No. 108 Electrical Coil Winding Machine, winner of an award from "Electrical Manufacturing" for product design, is equipped with a Maxitorq Clutch . . . one of many new Maxitorq installations in textile machinery.

If you are a product or machine designer you will discover in Maxitorq the solution to many problems in power transmission. Maxitorq gives you 8 sizes from ¼ to 15 H.P. in standard sizes . . . 6 sizes in the Automatic Overload Release type. Compact streamlined design, precision machining and a variety of rearrangements in installation and driving hookups make Maxitorq a versatile control for Machine Tools, Power Trucks, Textile and Printing Machinery, Packaging and Labeling equipment, Mining, Laboratory, Ordnance . . . and for many other types of industrial power operated machinery.

A high type of engineering service is available on request. Write us for details.

SEND FOR CATALOG No. ME11

THE CARLYLE JOHNSON MACHINE COMPANY
MANCHESTER • CONNECTICUT

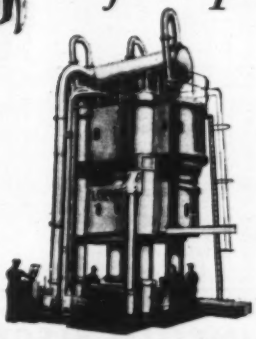
4C-52

FROM PLANNING *to full-speed operation*

WE DESIGN, BUILD AND EQUIP:

Forging Plants • Extrusion Plants • Powder Metal Plants • Precision Deep Drawing Installations • High Pressure Hydraulic Systems • Rolling Mills and Auxiliaries

And any Installation for Hot and Cold Working of Ferrous and Non-Ferrous Metals



L.C.C. SERVICES

Singly or in any desired Combination

●

Consulting and Engineering

●

Research and Development: Materials, Methods, Machinery, Operations

●

Shop Layouts

●

Planning, Designing and Building of Entire Projects

●

Complete Plants Erected and ready to operate

●

Re-Design and Modernization of Existing Plants

●

Design, Engineering and Construction of Hydraulic Machinery, Rolling Mills, Material Handling Equipment etc.

LOEWY CONSTRUCTION CO., Inc.

SUBSIDIARY OF HYDROPRESS INC.

350-M Fifth Avenue *(Empire State Building)* New York 1, N. Y.

Birmingham, Ala. ● Chicago, Ill. ● Cleveland, Ohio ● Detroit, Mich. ● Los Angeles, Calif. ● Phoenix, Arizona ● San Francisco, Calif. ● Seattle, Wash. ● Washington, D. C. ● Wheeling, West, Va.

Genoa, Italy ● London, England ● Madrid, Spain ● Paris, France ● Phillipine Islands

NEW LINCOLN PLANT CREATED BY INCENTIVE-INSPIRED CO-ACTION IN DEVELOPING POSSIBILITIES IN PRODUCT

© LE Co. 1952

WELDED DESIGN SAVES 25% ON COST

...cuts weight 26%

By **B. L. Kepp**, Plant Manager & Chief Engineer
Corson Brothers, Inc.
Indianapolis, Indiana

WELDED design enables us to make the most efficient use of materials in the manufacture of our "Seedmaster". Formerly it was necessary to use heavy wall sections with gray iron because of casting restrictions. With steel we now fabricate a more rigid, more dependable product using metals as light as 12 gauge. On this one machine, for example, weight was cut from 23 to 17 pounds. Since welded steel is easier to fabricate, our shop costs have been lowered by 25%. Former field service problems of breakage have been eliminated.

In addition to components shown in Figures 1 and 2, the main frame was also converted to welded steel. In place of a solid cast rectangular member, the main frame is now formed from 12 gauge steel with rolled edges for rigidity. The steel design is easier to assemble and has greater sales appeal.

Fig. 3. Original Construction *of "Seedmaster" frame built by Corson Brothers, Inc. Weighed 23 pounds, was subject to fracture.*

Fig. 4. Present Welded Steel Design. *Steel members replace cast components, prove to be lighter, but stronger in construction, yet are formed from 12 gauge sheet.*

PROPER DESIGN IN WELDED STEEL IMPROVES PRODUCT LOWERS COST

Fig. 1. Former Design *of bracket was gray iron . . . is now fabricated from 12 gauge steel. Steel design is rugged, durable, will not fracture.*

Fig. 2. Support Arm *originally a casting, required costly milling and drilling. Wall section was ½". Is now formed from 12 gauge material, has greater strength, increased rigidity, less weight.*

SAVES MATERIAL
LOWERS COST

Machine Design Sheets available on request. Designers and Engineers write on your letterhead to Dept. 404

THE LINCOLN ELECTRIC COMPANY
CLEVELAND 17, OHIO

THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT

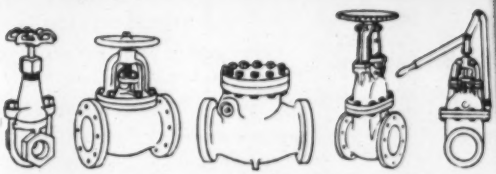
IRON

COMPLETE LINES OF IRON VALVES AND PIPE FITTINGS are manufactured by Walworth in a variety of types, pressure ratings, sizes, and patterns for general industrial use.

Walworth also manufactures complete lines of valves (including Lubricated Plug Valves), and pipe fittings made of steel, bronze, and special alloys.

These valves and pipe fittings, plus Walworth-made pipe wrenches total approximately 50,000 items and are sold through distributors in principal centers throughout the world.

Walworth engineers will be glad to help you with your problems. For further information call your local distributor, nearest Walworth sales office, or write to Walworth Company, General Offices, 60 East 42nd Street, New York 17, New York.



Iron valves in gate, globe, angle, check, and lubricated plug types are manufactured by Walworth. Illustrated is a sectional view of a Walworth No. 726F Standard Iron Body, Bronze Mounted, Wedge Gate Valve with flanged ends. This line of valves is available in sizes 2 to 30 inches. Similar valves of All-Iron type are also available.

WALWORTH

Manufacturers since 1842

valves . . . pipe fittings . . . pipe wrenches

60 East 42nd Street, New York 17, N. Y.

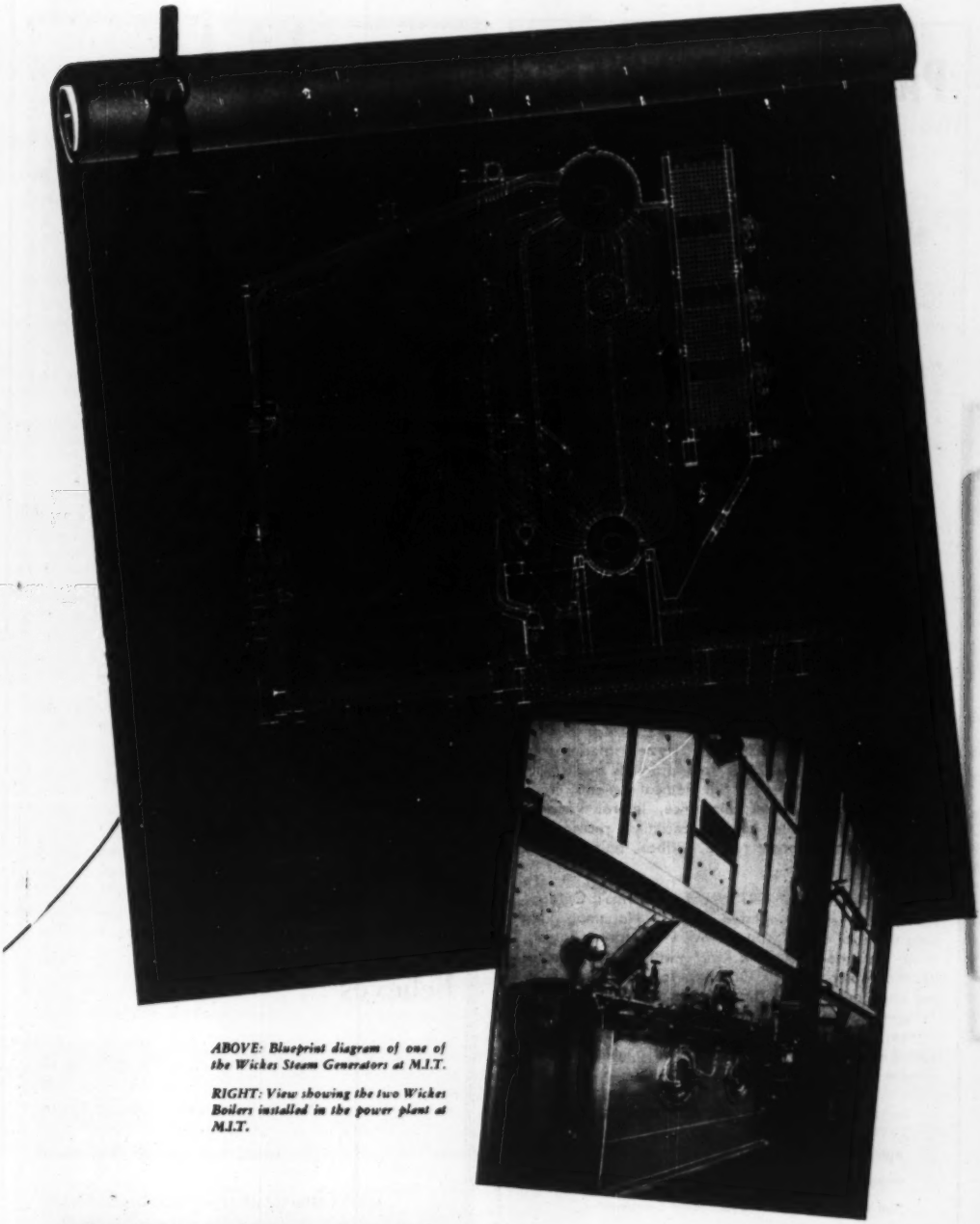
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

M.I.T., famous engineering school, uses WICKES boilers for steam production

Consultants — JACKSON & MORELAND, ENGINEERS of Boston, Mass.

AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY, where sound engineering principles are taught, two Wickes Steam Generators were selected to supply heat for several new buildings including the Hayden Library and Sloan Metals Research Laboratory. The Wickes Boilers, which were custom-engineered for M.I.T., produce 160,000 lbs., of steam per hour. They occupy the same space formerly occupied by the two old boilers that produced only 40,000 lbs. per hour. They are equipped with superheaters and economizers. The new boilers are oil-fired at present but are engineered for ready conversion to spreader stoker if desired. They are designed for quick steaming to meet emergency power requirements and are fitted with thermowells and openings for taking flue gas samples so the students at M.I.T. can run boiler tests as part of their instruction. The installation of these boilers, an extremely difficult job because of the close erection tolerances, was handled by Flagg, Brackett & Durgin, Inc., Wickes' agents in Boston. ✓ ✓ ✓ Wickes can fill your requirements for steam generators up to 250,000 lbs. per hour and 1000 psi.—all types of multiple drum boilers adaptable to any standard method of firing; oil, gas, underfeed or spreader stoker. Write today for descriptive literature or consult your nearest Wickes representative.

RECOGNIZED QUALITY SINCE 1854



ABOVE: Blueprint diagram of one of the Wickes Steam Generators at M.I.T.

RIGHT: View showing the two Wickes Boilers installed in the power plant at M.I.T.

WICKES

THE WICKES BOILER CO.

142

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

SALES OFFICES: Atlanta • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver • Detroit • Greensboro, N.C. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Pittsburgh • Portland, Ore. • Saginaw • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D.C

PACIFIC NORTHWEST OPPORTUNITY

for

MECHANICAL ENGINEERS

HYSTER COMPANY—manufacturer of the world's most complete line of tractor equipment and industrial lift trucks, has a number of openings in these categories:

- **Design Engineers**
- **Production Engineers**
- **Senior Engineers**
- **Supervising Engineers**
- **Tool Design Engineers**
- **Junior Engineers**
- **Project Engineers**
- **. . . and others**

These job opportunities result from the steady growth of the company, and are known to our personnel.

HYSTER OFFERS THESE BENEFITS:

OPPORTUNITY FOR ADVANCEMENT. Hyster is a young, aggressive organization which places a premium on ability, energy, and talent. You, as an individual, initiate and complete your own project.

JOB STABILITY. Hyster products enjoy a stable market in peace time, as well as during defense-accelerated periods.

TOP SALARY AND BENEFITS. Hyster salaries rank with the best in industry. Your progress and salary are reviewed quarterly. Full medical benefits, credit union, generous travel allowance, liberal vacation schedules, adequate housing facilities, recreational facilities such as target range, softball, golf, bowling, etc.

LIFE IN THE GREAT NORTHWEST—America's Outdoor Playground. No congested traffic. No smog. No long drive to work. You can live in evergreen forests, or on the broad Columbia River—within a few minutes of your office. Enjoy Oregon's famed fishing, hunting and camping. Portland offers the finest in urban living—plus boating, water sports, more than 30 golf courses, many recreational parks, rose gardens, a fine school system for your children, and a mild, equable climate the year around.

HYSTER IS ONE OF THE FASTEST GROWING COMPANIES IN THE PACIFIC NORTHWEST—AND INVITES YOU TO GROW WITH IT.

Write Us Today, Stating Your Qualifications.

Your Application Will Be Given Prompt Consideration.

Write to: Mr. R. W. Ager

HYSTER COMPANY

2902 N. E. Clackamas

Portland 8, Oregon

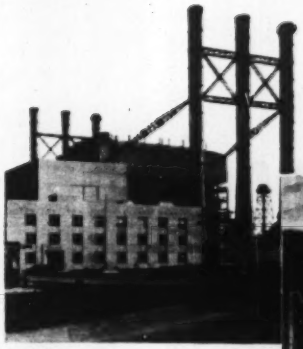
Every Advertiser appearing in the ASME Publications . . .

MECHANICAL ENGINEERING

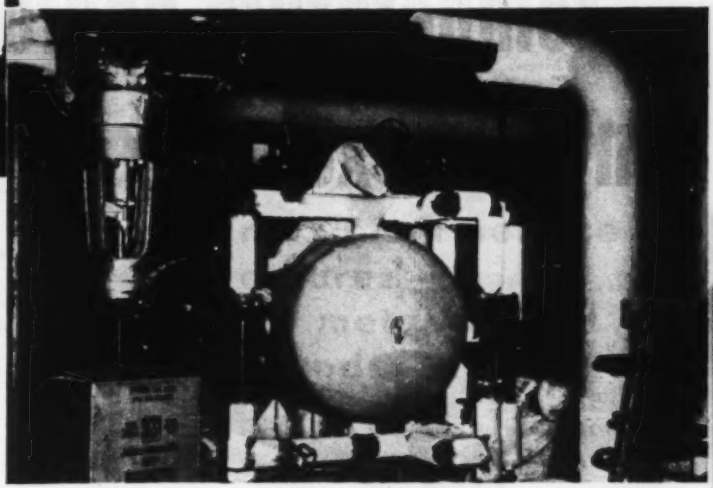
and ASME MECHANICAL CATALOG

believes . . .

that his products . . . the service in them and the service behind them . . . will stand up under the most searching scrutiny of the high calibre engineers and executives whom these publications serve.



At the new Moss Landing generating plant



(Top) Moss Landing, California steam plant of the Pacific Gas and Electric Company, designed by Stone and Webster Engineering Corporation, under the supervision of the P. G. and E. Engineering Dept.

(Right) Skilled applicators of an outstanding J-M Insulation Contractor, Western Asbestos Company of San Francisco, applying J-M 85% Magnesia to pipelines during construction of the Moss Landing plant.

P. G. and E. INSULATES WITH SUPEREX-85% MAGNESIA TO LOWER POWER PRODUCTION COSTS

When Pacific Gas and Electric Company invested $80,000,000 in its new 771,000-horsepower electric generating giant at Moss Landing, California...the insulation, like all other materials, had to meet rigid specifications. *For this important project, Johns-Manville Superex-85% Magnesia double-layer insulation was used on superheated steam pipes.*

Superex Combination Insulation consists of Superex*, a J-M insulation for temperatures to 1900F, and J-M 85% Magnesia. It was installed at the Moss Landing plant for maximum thermal efficiency and long trouble-free service. This double-layer construction, proved in over a quarter-century of outstanding on-the-job performance, utilizes the higher heat resistance of Superex next to the hot surface—the greater insulation value of J-M 85% Magnesia for the outer layer. It eliminates through joints, protects the jacket against scorching and is unharmed by expansion encountered in pipes carrying superheated steam.

J-M 85% Magnesia is the leading insulation for temperatures to 600F. It will not distort regardless of its length of service. It fits snug, stays tight. Heat savings, therefore, remain constant for the life of the equipment on which it is applied.

Whatever the insulation—it must be properly engineered and installed to pay maximum dividends. That's why Johns-Manville offers industry the services of experienced J-M Insulation Engineers and J-M Insulation Contractors. These men stand ready to combine their talents and give you an insulation job that will more than pay off your initial investment with maximum fuel savings.

For further information, write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

Double-Layer Superex-85% Magnesia Insulation was used on superheated piping at the P. G. and E. Moss Landing plant.

*Reg. U. S. Pat. Off.

Johns-Manville FIRST IN INSULATION

MATERIALS • ENGINEERING • APPLICATION

Now... closer temperature approaches in heat exchange

WITH TRANE BRAZED ALUMINUM SURFACE

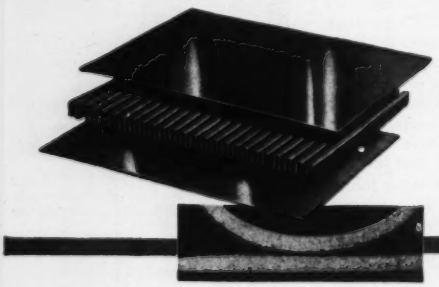
Now . . . even with a large temperature change or drop . . . you can obtain *temperature approaches of 5° to 10° F.*

TRANE Brazed Aluminum heat exchange surface makes it not only possible—but *practical!* That's because the new TRANE Brazed Aluminum packs up to 450 square feet of surface into a single cubic foot of space.

This huge amount of surface in a single unit makes maximum use of available pressure drop. And you don't lose pressure through connections.

TRANE Brazed Aluminum can handle heat transfer between three, four, five or more streams simultaneously —liquid to liquid, liquid to gas, or gas to gas. Temperatures from 500° F. to -300° F. Tested at pressures up to 1000 Psig.

Want more information? Contact your nearest TRANE sales office, or write The TRANE Company, LaCrosse, Wis.



WHAT IS BRAZED ALUMINUM? A stack of flat plates and corrugated fins in layers, all brazed in perfect bond. Strong, light, compact and completely flexible. Illustration below shows strong fillet formed between fin and plate.

TRANE

THE TRANE COMPANY, LA CROSSE, WIS.
Eastern Mfg. Division, Scranton, Pa.
Trane Company of Canada, Ltd., Toronto
Offices in 80 U.S. and 14 Canadian Cities

MANUFACTURING ENGINEERS OF HEATING, VENTILATING, AIR CONDITIONING AND HEAT TRANSFER EQUIPMENT

LADISH

Controlled Quality

PIPE FITTINGS

maximum service assured by metallurgical soundness

Sound metallurgy . . . the result of unsurpassed facilities and advanced laboratory controls . . . provides the maximum of dependability in Ladish Controlled Quality fittings. Every phase of metal quality . . . composition, structure and physical properties . . . is continuously safeguarded — and certified proof of metallurgical integrity is available to users of Ladish fittings.

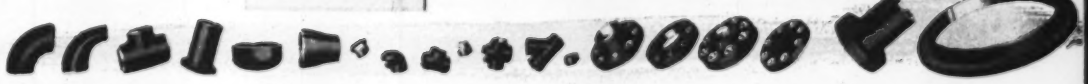
TO MARK PROGRESS

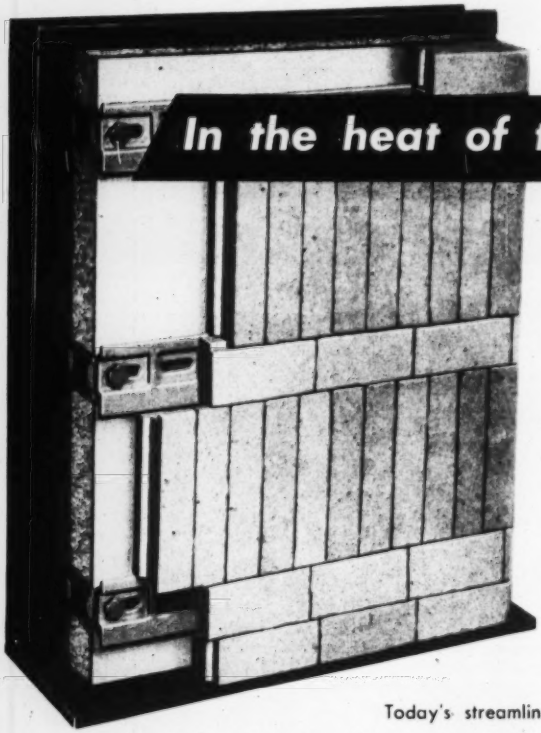
THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF . . . ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
St. Louis • Atlanta • Houston • Tulsa • Los Angeles • San Francisco • Havana • Mexico City • Brantford, Ont.





In the heat of things.....

USE

BIGELOW-LIPTAK THIN WALLS IN BOILER CONVECTION AREAS

Note: The ample tile offsets, how the thin wall is truly unit suspended.

Today's streamlined boiler enclosures utilize Bigelow-Liptak thin walls in convection areas and behind water walls where low temperature and not-so-severe operating conditions are encountered.

Furnace linings of this type combine thin walls with thicker construction or tube-supported walls for a well-balanced heat enclosure. Initial costs, as well as maintenance and costly outage time, are substantially reduced while furnace efficiency remains high.

Like all Bigelow-Liptak construction, thin walls are unit suspended. Refractories are hung from castings which, in turn, are supported by a structural steel framework. Three-ply insulation seals effectively block against heat drains and air infiltration. Walls can be curved or sloped.

Flexible thin walls are used, not only for boiler walls, but for dryer furnaces, refinery vessels, cement clinker coolers and many other applications.

Important!... A new bulletin describing the history of B-L thin walls is now being published. Reserve your copy today.

BIGELOW-LIPTAK *Corporation*

and Bigelow-Liptak Export Corporation

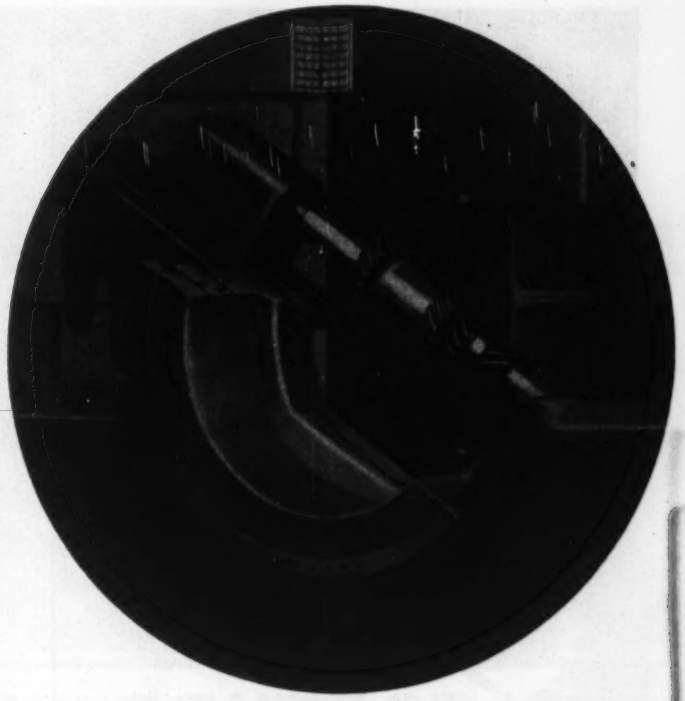
2550 W. GRAND BLVD. • DETROIT 8, MICHIGAN

UNIT-SUSPENDED WALLS AND ARCHES

In Canada: Bigelow-Liptak of Canada, Ltd., *Toronto, Ontario*

ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DENVER • HOUSTON • KANSAS CITY, MO. • LOS ANGELES • MINNEAPOLIS • NEW YORK
PITTSBURGH • PORTLAND, ORE. • ST. LOUIS • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SAULT STE. MARIE, MICH. • SEATTLE • TULSA • VANCOUVER, B.C.

here's a practical way to check spur and helical gears



The Kodak Conju-Gage Gear Checker automatically records the composite effects of runout, base pitch error, tooth thickness variation, profile error, lead error, and lateral runout. Illustrated is the Kodak Conju-Gage Gear Checker, Model 4U, for gears up to 4½" pitch diameter. Larger and smaller models are also available.

In the final analysis, the accuracy of a gear is judged by whether or not it is good enough for the job.

Individual checks on errors such as profile error and pitch error can show tolerable variations which could combine to give a result intolerable in performance. Conversely, two intolerable errors might cancel out. But the composite check recommended in the American Standard (AGMA 236.02; ASA B6.11-1951) tests gears in action—tells at once whether or not the gear will do the job required.

With a Kodak Conju-Gage Gear Checker, you can check composite error to the closest tolerances. The reason lies in the Kodak Conju-Gage Worm Section. A single Worm Section, replacing a collection of master gears, can be used to check any spur or helical gear of any helix angle providing it has the same normal pitch and pressure angle. Its inherently simple and accurate form permits grinding to tolerances almost impossible to obtain in circular masters, especially in finer pitches.

Quick, conclusive, and accurate, the Kodak Conju-Gage Gear Checker makes it easy to meet specifications limiting tooth-to-tooth composite error to as little as .0002". It automatically writes records to hold or ship with finished gears. And the gaging element can be checked in your own toolroom—economically reground to original specifications if necessary.

To find out how the Kodak Conju-Gage Gear Checker can solve your precision inspection problems, send for the booklet, "Kodak Conju-Gage Gear Testing Principle." It's yours for the asking by writing to Eastman Kodak Company, Industrial Optical Sales Division, Rochester 4, N. Y.

CONJU-GAGE INSTRUMENTATION

. . . a new way to check gear precision in action

To inspect all kinds of complex parts on a bright screen, Kodak also makes two highly versatile contour projectors.

Kodak

TORTURE CHAMBER

for VALVE and FITTING MATERIALS

Here, steam up to 1500 pounds pressure and 1000° F. gives Vogt the answer to any question of materials or construction for valves and fittings in just a few days . . . facts that would take years to obtain under normal operating conditions!

We set up our own Torture Chamber to determine the durability of valve packings and gaskets; the resistance of various steels to corrosion and erosion; and how hard and how smooth surfaces of seats, discs and stems must be to withstand steam at high pressures and high temperatures. We tested and found an ideal yoke nut material, and we uncovered facts on joint design that could be found in no other way.

Thus, by constant and accelerated testing, we quickly and definitely prove or disprove the claims that are made for many newly developed materials. And thereby we make sure that only the best goes into valves and fittings that bear the name Vogt.

Consult Catalog F-9 for the complete Vogt line of drop forged steel valves, fittings and flanges for steam, water, oil, gas, air and refrigeration services.

HENRY VOGT MACHINE CO., Louisville 10, Ky.

BRANCH OFFICES: NEW YORK • CHICAGO • CLEVELAND
PHILADELPHIA • ST. LOUIS • DALLAS • CHARLESTON, W. VA.

Vogt

DROP FORGED STEEL VALVES and FITTINGS

HOW MORRIS, WHEELER & CO., INC.

CUT Original Cost : CUT Operating Cost

SAVED SPACE • SAVED WEIGHT

with FOOTE BROS. Line-O-Power Drives

On overhead cranes manufactured by the Monorail and Crane Division, Morris Wheeler & Co., Inc., two Line-O-Power Drives are aiding in reducing costs, saving space and saving weight.

These compact drives incorporate Duti-Rated precision gears which have tooth surfaces of high hardness with tough ductile cores assuring years of wear-life even under tough service.

You will find these drives ideal for use in your plant or on the equipment you manufacture.

Efficiency 96% or higher. Capacities from 1 to 175 h.p. Ratios 5 to 1 up to 238 to 1.

Two Foote Bros. Line-O-Power Drives installed on overhead cranes manufactured by Monorail and Crane Division of Morris Wheeler & Co., Inc., Philadelphia.

FOOTE BROS.

Better Power Transmission Through Better Gears

Maxi-Power Drives

Hygrade Drives

Foote Bros.-Louis Allis Gearmotors

Foote Bros. Gear and Machine Corporation
Dept. Q, 4545 South Western Boulevard
Chicago 9, Illinois

Please send me a copy of Bulletin LPB on Foote Bros. Line-O-Power Drives.

Name.....

Company.....

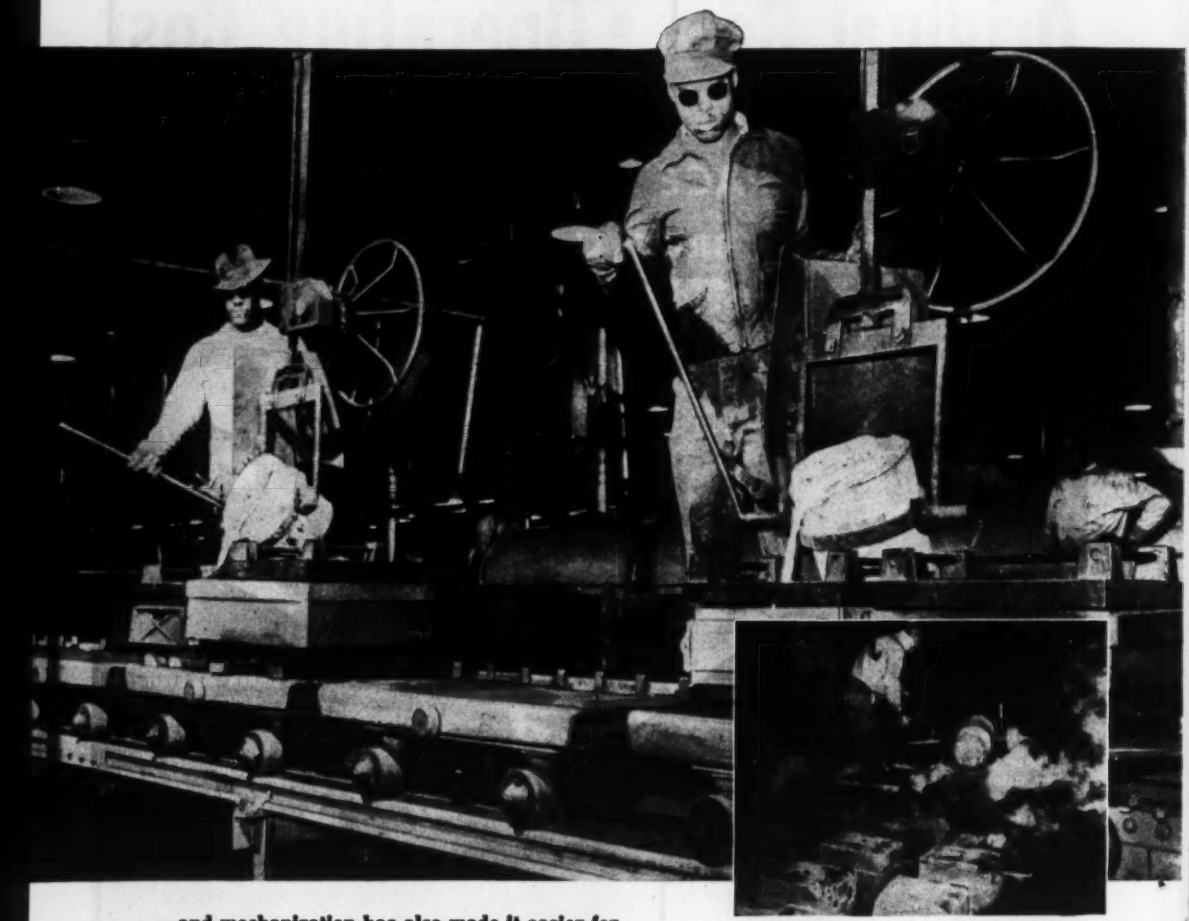
Position.....

Address.....

City.....Zone.....State.....

Link-Belt Research and Engineering . . . Working for Industry

Today's foundries produce more castings . . . at lower cost



. . . and mechanization has also made it easier for foundries to attract and hold dependable manpower

THE modern foundry utilizes production line techniques to cut costs. Conveyors speed the movement of sand, cores, molds, and castings . . . eliminate up to 80% of the manual lifting and carrying formerly required.

Frequently, foundries conveyorized by Link-Belt double their production in the same space. Worker productivity is increased . . . labor turnover sharply reduced. Mechanization by Link-Belt pays off right from the start.

Link-Belt research and engineering have helped advance production techniques in many other fields. In fact, in almost any plant you can name, you'll find Link-Belt equipment at work.

BEFORE and AFTER—Contrast laborious hand pouring with Link-Belt mechanization! Pourers now ride on platform conveyor synchronized with mold conveyor. Ladle is suspended from trolley on overhead track. Note absence of annoying smoke and fumes.

LINK-BELT

LINK-BELT COMPANY

Executive Offices: 12,984
307 N. Michigan Ave., Chicago 1, Ill.

Plants: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa), Sydney (Australia). Offices in Principal Cities.

ONE SOURCE . . . ONE RESPONSIBILITY FOR MATERIALS HANDLING AND POWER TRANSMISSION MACHINERY

Yours for the asking—

A VOLUME OF DATA

. . . covering welding fittings and forged steel flanges . . .

ON A SINGLE SHEET

Here is just about the handiest tool ever devised for the pipe designer. Data on welding fittings and flanges that otherwise could be found only by plowing through many catalog pages and tables have been ingeniously condensed on the two sides of the durable letter-size card illustrated above.

One side covers the broad WeldELL line of Taylor Forge welding fittings. For every nominal pipe size, ½" through 30", it shows the wall thickness for every weight of every fitting in every available material. It also shows all required dimensions of all types of fittings.

The other side covers the world's most complete line of forged steel flanges. For every nominal pipe size, ½" through 24", it gives all essential dimensional and bolting data for all types of flanges in all weights. A particularly useful table (see reproduction) is that showing welding neck flange bores which enables you to determine the I.D. of any nominal pipe size without separate calculation. Thus the sheet gives you O.D. and I.D. of any weight of pipe.

The card is varnished to make it stand the steady usage you are certain to give it. To obtain your copy see your Taylor Forge distributor or **MAIL THE COUPON.**

TF

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS

General Offices and Works: P. O. Box 485, Chicago 90, Ill.
Offices in all principal cities.
Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

Please send me one of your fitting and flange sheets:

NAME_____

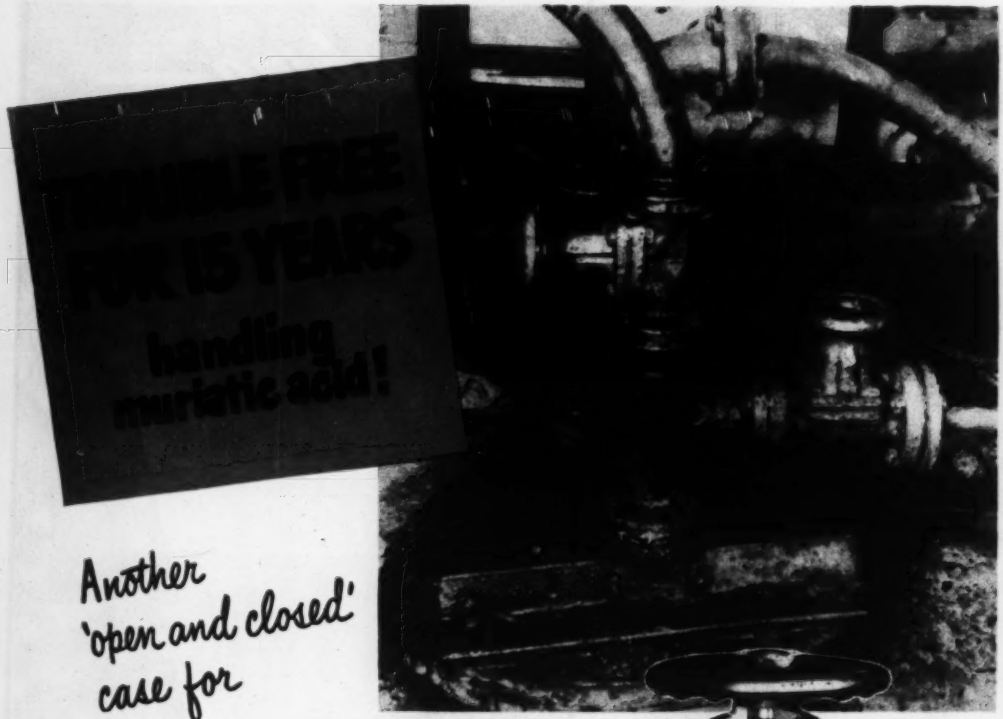
POSITION_____

COMPANY_____

STREET ADDRESS_____

CITY_____ ZONE____ STATE_____

504-1152 Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.



Another 'open and closed' case for

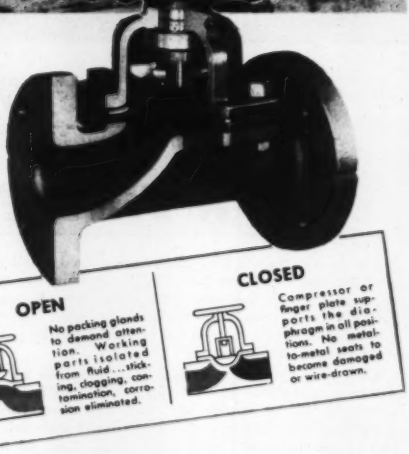
GRINNELL-SAUNDERS DIAPHRAGM VALVES

In 1936, a Canadian mine installed Saunders Diaphragm Valves with rubber linings on the feed and drain piping of an underground tank used for the storage of muriatic acid. Today, after 15 years, those *same* valves are in use—having required no maintenance except for periodic replacement of diaphragms, a simple operation done without removing the valve from the line.

Grinnell-Saunders Diaphragm Valves are available in many different combinations. Bodies are made in a variety of metals —iron, stainless steel, bronze, aluminum and others. *But of more importance* is the fact that a body of cast iron (a metal not in short supply) can be lined with glass, lead, natural rubber, neoprene and other materials which, in many instances, handle corrosive fluids *better* than metals.

Diaphragms come in natural rubber, neoprene, butyl, hycar, a special synthetic for foods and KEL-F. This last is chemically inert to all acids and alkalies in all concentrations with the exception of molten alkali metals.

From this broad selection of materials, the problems which the Grinnell-Saunders valve can solve are extremely varied. No wonder industry after industry is putting it on the line.


OPEN
No packing glands to demand attention. Working parts isolated from fluid ... sticking, clogging, contamination, corrosion eliminated.
CLOSED
Compressor or finger plate supports the diaphragm in all positions. No metal-to-metal seats to become damaged or wire-drawn.

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

Want More Uniform Results?

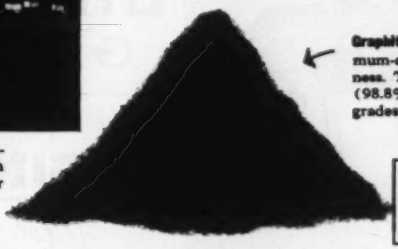
Specify NATIONAL Graphite Products for Powder Metallurgy

TRADE-MARK

PURITY • HIGH STRENGTH • LOW ASH
• HEAT RESISTANCE
• DIMENSIONAL STABILITY

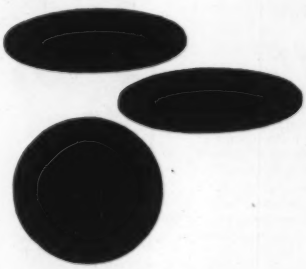
Wherever powders become parts, efficiently and profitably, a lot depends on electric furnace graphite in its various, accurately-controlled grades. Here, for example, are a few applications in which National Carbon's leadership in graphite research may handsomely reward your insistence upon the finest graphites obtainable.

Graphite Molds for Hot Pressing. Available in all required high-strength grades, either as finished molds or as bar stock.

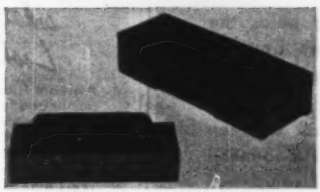


Graphite Powders. Guaranteed minimum-ash grades of specified fineness. Their electrographitic purity (98.8%) is unmatched by natural grades.

GRAPHITE COLLAR FOR WATER-COOLED COPPER CONNECTOR RING



Graphite Spacer Discs. Supplied in diameters up to 30", with accurately-ground parallel faces.



Graphite Sintering Boats. Machined from solid graphite stock to withstand temperatures over 3000 F without distortion. Extra high strength and ultra high purity grades to meet requirements.

Carbon and Graphite Tubes for Resistance Furnaces. Furnished "as extruded" or, where more uniform wall thickness is required, lathe-turned and bored from solid stock.

ENGINEERING ASSISTANCE IN THE APPLICATION OF "NATIONAL" GRAPHITE PRODUCTS IS AVAILABLE THROUGH THE DISTRICT OFFICES LISTED BELOW

DOLLARS and SENSE

. . . point to "Eveready" No. 1050 Industrial Flashlight Batteries . . . the cells that deliver twice as much usable light as any battery we've ever made before. Their unique construction prevents swelling or jamming in the case . . . has no metal can to leak or corrode.

The terms "National" and "Eveready" are registered trade-marks of Union Carbide and Carbon Corporation

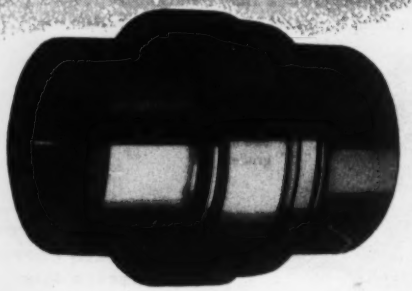
NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, New York

DISTRICT SALES OFFICES: ATLANTA • CHICAGO • DALLAS • KANSAS CITY • NEW YORK • PITTSBURGH • SAN FRANCISCO
IN CANADA: NATIONAL CARBON LIMITED • MONTREAL • TORONTO • WINNIPEG

THIS NEW SPRING!

Adds 50% to Safe Top Speeds of

LOVEJOY FLEXIBLE COUPLINGS



A new multiple leaf spring holds the collar in place — enables this Lovejoy Coupling to withstand considerably higher speeds with complete safety. Free-floating load cushions suspended between heavy metal jaws — no metal-to-metal power transmission. Instant adjustment for shock, vibration, surge, backlash and misalignment. No lubrication needed. Cushions available for every duty . . . 1/6 to 2500 h.p.

WRITE TODAY FOR COMPLETE CATALOG AND QUICK-FINDING SELECTOR CHARTS.

LOVEJOY FLEXIBLE COUPLING CO.

5032 W. Lake Street Chicago 44, Illinois

Also Mfrs. Lovejoy Universal Joints and Lovejoy Variable Speed Transmissions

ENGINEERED FOR PRODUCTION

Diefendorf makes gears to meet the exacting standard of the engineer who designs for production—quality in material and workmanship.

All materials. All styles.

DIEFENDORF GEAR CORP.

Syracuse, New York

DIEFENDORF GEARS

ENGINEERS:

We've Got what you're Looking for!

A secure future, exceptional opportunities for advancement, and a high starting salary await you at FAIRCHILD. We have openings right now for qualified engineers and designers in all phases of aircraft manufacturing; we need top-notch men to help us in our long-range military program: turning out the famous C-119 Flying Boxcar and other projects for the U.S. Air Force.

FAIRCHILD provides paid vacations and liberal health and life insurance coverage. We work a 5-day, 40-hour week as a base. Premium is paid when longer work week is scheduled.

T. H. Beck, Manager of Engineering. Is an engineering veteran of over 22 years in the aviation and related industries.

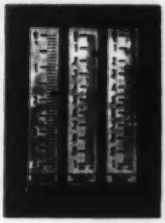
ENGINE AND AIRPLANE CORPORATION

FAIRCHILD *Aircraft Division*

HAGERSTOWN, MARYLAND

EASIER TO *Read*

Beside the foolproof, precision mechanism which insures utmost accuracy in ELLISON Draft Gages, they are easier to read—both the Straight-Line and Dial type gages. Scales are of translucent glass with distinct black graduations printed on the glass by special process. Accurate readings from any viewpoint.



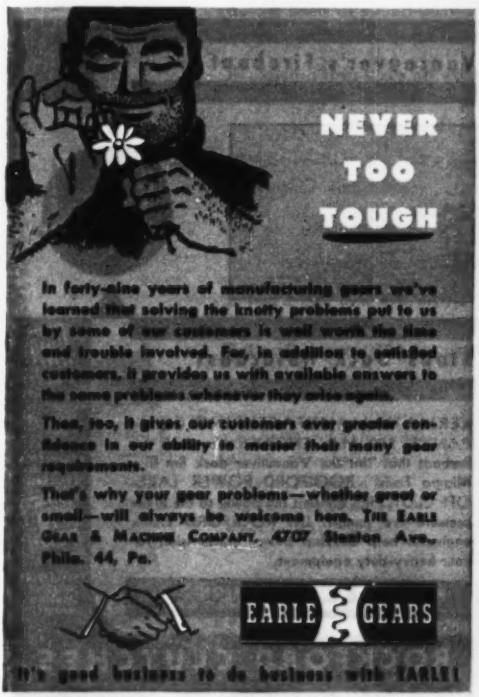
With engineers who want freedom from gage worries it's ELLISON. Bulletin 122 describes Straight-Line and Dial Bell Gages —Bulletin 124 for Straight-Line Diafram Gages.

ELLISON DRAFT GAGE CO.

552 W. MONROE ST. Since 1896 CHICAGO 6, ILL.

THE ELLISON LINE ALSO INCLUDES:

Dial Draft Gages-Bell Type — Inclined Draft Gages — Portable Inclined Vertical Tube Gages — Vertical Tube Gages — Oil, Heavy Liquid and Mercury — Single and Multi-Tube-Saturator Gages — U Gages — Stationary and Portable — Air Filter Gages — Dial and Inclined Tube Types — Pitots Tubes — U Path Steam Calorimeters — Portable Gas Analyzers-Orsat Type


NEVER
TOO
TOUGH
In forty-nine years of manufacturing gears we've learned that solving the knotty problems put to us by some of our customers is well worth the time and trouble involved. For, in addition to satisfied customers, it provides us with available answers to the same problems whenever they arise again.
Then, too, it gives our customers ever greater confidence in our ability to master their many gear requirements.
That's why your gear problems—whether great or small—will always be welcome here. THE EARLE GEAR & MACHINE COMPANY, 4707 Stenton Ave., Phila. 44, Pa.
EARLE GEARS
It's good business to do business with EARLE!

custom-designed for strength and sensitivity

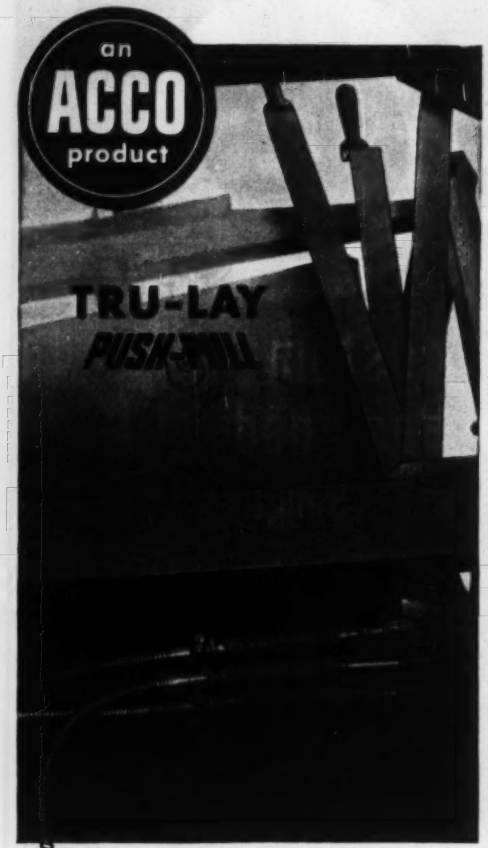
In Honeywell control valves, a Linear Precision-molded diaphragm provides the combination of strength and sensitivity demanded by modern process control. It translates the slightest change in air pressure into a related motion of the valve stem. Custom-engineered for this job, the diaphragm lasts for millions of cycles . . . retains its sensitivity . . . takes heavy over loads and temperature changes in stride.

Your diaphragm applications can benefit by Linear's design and production know-how. Why not consult us on all your diaphragm problems?

"PERFECTLY ENGINEERED PACKINGS"

LINEAR

LINEAR, Inc., State Rd. & Levick St., Philadelphia 35, Pa.



SOLID... as a rod

FLEXIBLE... as a wire rope

TRU-LAY Push-Pulls snake around obstructions. Provide positive remote action for operating clutches, gates, slides, etc. Operate while flexing. Weatherproof, dustproof types. Capacities up to 1000 pounds input.

Write our Detroit office today for DH-287

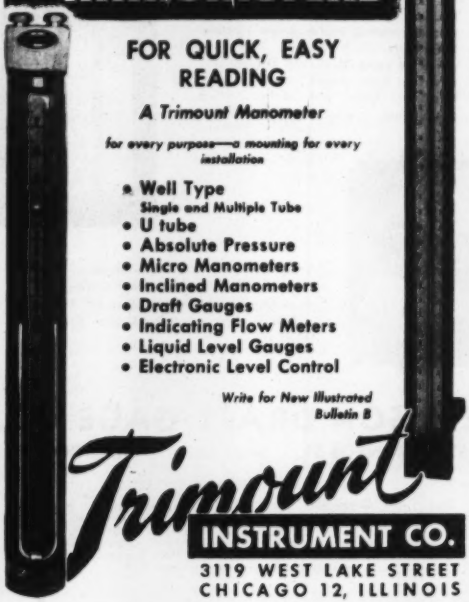
TRU-LAY PUSH-PULL CONTROLS

ACCO

AUTOMOTIVE AND AIRCRAFT DIVISION
AMERICAN CHAIN & CABLE

601 Stephenson Bldg., Detroit 2
2475 Porter St., Los Angeles 21 • Bridgeport, Conn.

ACCURACY
is built into these sturdy
MANOMETERS



FOR QUICK, EASY READING

A Trimount Manometer

for every purpose—a mounting for every installation

- **Well Type**
  Single and Multiple Tube
- **U tube**
- **Absolute Pressure**
- **Micro Manometers**
- **Inclined Manometers**
- **Draft Gauges**
- **Indicating Flow Meters**
- **Liquid Level Gauges**
- **Electronic Level Control**

Write for New Illustrated Bulletin B

Trimount
INSTRUMENT CO.
3119 WEST LAKE STREET
CHICAGO 12, ILLINOIS

Vancouver's Fireboat

Stops Dock Holocaust

KERMATH MANUFACTURING COMPANY'S 550 H.P. ENGINES powered the fireboat that "hit the Vancouver dock fire like Niagra Falls". ROCKFORD POWER TAKE-OFF CLUTCHES transmit the power to the high-pressure fire pumps. Let ROCKFORD clutch engineers help develop power transmission for your heavy-duty equipment.

ROCKFORD CLUTCH DIVISION
Eighteenth Avenue, Rockford, Illinois, U.S.A.

B-W ENGINEERING MAKES IT WORK
B-W PRODUCTION MAKES IT AVAILABLE
ENGINEERING BULLETIN SENT ON REQUEST

ROCKFORD CLUTCHES

Why should I buy ZALLEA Expansion Joints?

That is a fair question . . . and here is our answer:

The industrial buyer today is looking more and more closely at the comparative feature-for-feature value of the products he buys.

It has become increasingly necessary for his purchases to justify themselves on the basis of sound business economy—for increased production, economical service, or some other factor.

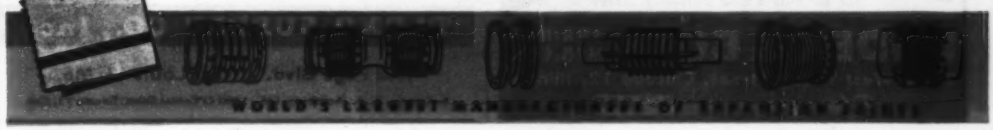
Expansion joints are no exception in this buying philosophy. That's why we at Zallea Brothers devote our entire efforts to the manufacture of one product—the finest expansion joints it is possible to produce.

When you buy Zallea Expansion Joints you receive something that never appears on an invoice . . . the *assurance* that you've bought the best! And you'll share this feeling of assurance with thousands of other customers who, for almost a quarter of a century, have relied on Zallea Expansion Joints for trouble-free economical service.

If you'd like to know more, call in your Zallea Representative. He'll be happy to give you complete, helpful information at no obligation on your part. Zallea Brothers, 820 Locust Street, Wilmington 99, Delaware.

Catalog 47 and Bulletin 351 describe the complete line of Zallea Expansion Joints and Flexible Connectors. Write for copies today.

Zallea
EXPANSION JOINTS

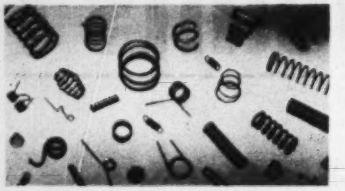


FOR Quality Performance from SPRINGS

WIRE FORMS

METAL STAMPINGS

Rely on DUDEK & BOCK



SPRINGS

Facilities range from .003 up to .148 in round wire. Up to .105 in square wire.

WIRE FORMS

Four-Slide wire machinery with punch press attachments handle from .005 to .248 inch wire diameter.

METAL STAMPINGS

Handles flat stock thicknesses from .005 to .093 and widths up to 3 inches.

You get precision Springs and Stampings that are easily assembled . . . that withstand stresses . . . perform under the most *trying* conditions. Rely on our EXPERT ENGINEERS to produce designs that meet your *exact* needs —and save you MONEY!

FREE VALUABLE BROCHURE *Send Today*

SPEEDY DELIVERY

WRITE — WIRE or PHONE *for Estimates and Delivery Dates*

DUDEK & BOCK SPRING MFG. CO.

2100 West Fulton Street, Chicago 12, Illinois

Phone: HAymarket 1-1880

when better SYNCHROS are required SPECIFY *Telesyn*

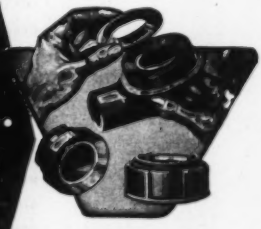
FORD

- Proved Precision Accuracy
- Meet Government Specifications
- Corrosion Resistance
- Fungus Resistance
- Available in wide selection of sizes

WRITE FOR NEW TELESYN BROCHURE

Division of the Sperry Corporation
31-10 Thomson Avenue
Long Island City 1, N. Y.

SIMPLICITY of DESIGN...



For Moving Pipe Lines

FLEXO JOINTS

For safe, unrestricted flow, Flexo Joints offer the strength of pipe *plus* the flexibility of hose — to convey fluids through movable pipe lines or to equipment while in motion. Just four simple parts, completely enclosed—no springs—no small or loose parts . . . long wear—low maintenance. Four styles—standard pipe sizes ¼" to 3".

Write for complete information.

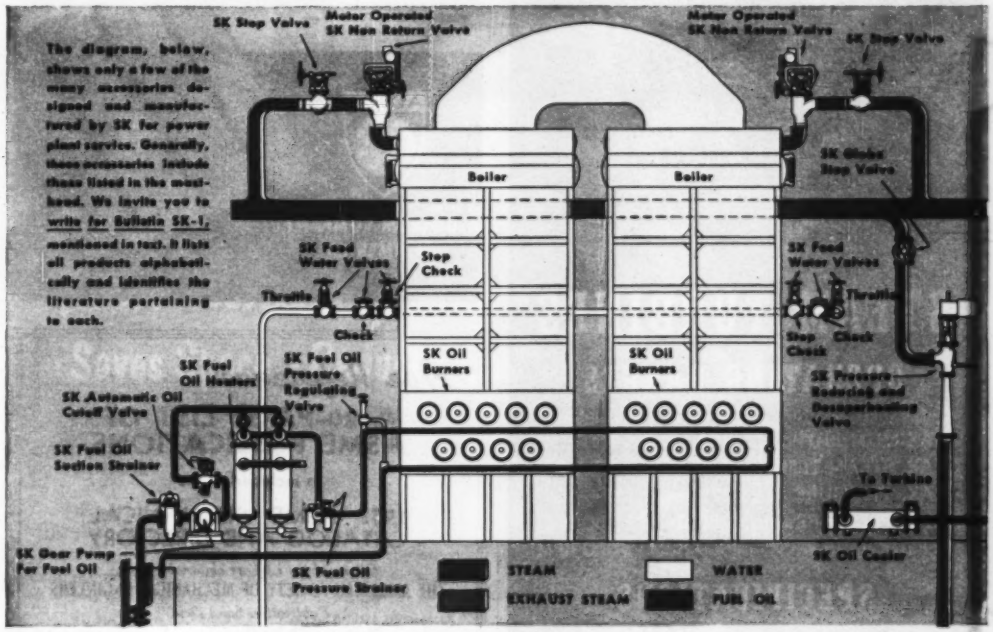
FLEXO SUPPLY CO., Inc.

4652 Page Blvd. St. Louis 13, Mo.

In Canada: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 13, Ont.

SK News

WANT ENGINEERING ASSISTANCE IN APPLYING HIGH PRESSURE POWER PLANT ACCESSORIES?


The diagram, below, shows only a few of the many accessories designed and manufactured by SK for power plant service. Generally, these accessories include those listed in the masthead. We invite you to write for Bulletin SK-1, mentioned in text. It lists all products alphabetically and identifies the literature pertaining to each.
SK Stop Valve
Motor Operated SK Non Return Valve
Motor Operated SK Non Return Valve
SK Stop Valve
Boiler
Boiler
SK Globe Stop Valve
SK Feed Water Valves
Stop Check
Throttle
Check
SK Feed Water Valves
Throttle
Stop Check
Check
SK Fuel Oil Heaters
SK Fuel Oil Pressure Regulating Valve
SK Oil Burners
SK Oil Burners
SK Automatic Oil Cutoff Valve
SK Pressure Reducing and Desuperheating Valve
SK Fuel Oil Suction Strainer
To Turbine
SK Gear Pump For Fuel Oil
SK Fuel Oil Pressure Strainer
SK Oil Cooler
STEAM
WATER
EXHAUST STEAM
FUEL OIL

You can get it from us.

For over 75 years, SK has specialized in *engineered products for the power plant.*

In that time, the company has worked closely with thousands of power and consulting engineers to properly apply accessories ranging from standard fuel oil burners to specially engineered multi-nozzle pressure reducing and desuperheating valves.

Those who don't realize the *economic importance* of years of service and wide experience belittle these intangibles.

Just you remember — the design or manufacturing problem we solved yesterday or seventy-five years ago can well provide the basis for solving a problem of your own *at lower cost* than would otherwise be possible. And, remember that every technique perfected at some previous time, every pattern, tool, and machine already on hand means *less cost to be passed along to you.*

Do you want help on some specific power plant problem? Write us, and we will have one of our field engineers visit you.

Want some idea of the many accessories we manufacture? Send for a copy of Bulletin SK-1, "Index of SK Equipment and Descriptive Bulletins," look it over, and write for the specific technical literature you need.

Manufacturing Engineers

Wing

STEAM TURBINES

OPERATING RANGES

MAXIMUM BHP	100	150
MAX. STEAM TEMP.	825° F	750° F
MAX. PRESSURE	275 lbs.	600 lbs.
BACK PRESSURE up to	50 lbs.	50 lbs.
SPEEDS up to	4000 RPM	4000 RPM

SPECIFICATIONS

ROTOR ... STUFFING BOXES ...
BUCKETS ...
NOZZLES ... BEARING CAPS ...
... VERTICAL SHAFTS ...
LUBRICATION ...
... ROTATION ...
GOVERNORS ...
TRIP & SPEED REGULATING ...

L. J. Wing Mfg. Co.

Vreeland Mills Road, Linden, New Jersey

Factories: Linden, N. J., Montreal, Canada
Offices in Principal Cities

Q Can you put VITREOUS ENAMEL on ALUMINUM?

A Yes—SEE ALCOA. Alcoa's finishing laboratories are continually improving and developing finishes for aluminum—painted, electroplated, anodized plus chemical and mechanical treatments. For the latest information, simply write on your company letterhead to:

ALUMINUM COMPANY OF AMERICA
1978-L Gulf Building Pittsburgh 19, Pa.

ZOURITE FACING MATERIAL
Manufactured by The Kawneer Company, Niles, Michigan

ALCOA

ALUMINUM COMPANY OF AMERICA

For Reference

A 20-PAGE LIST OF ASME PUBLICATIONS

is included in the

1953 ASME MECHANICAL CATALOG AND DIRECTORY

Copies of the List are obtainable from

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Publication-Sales Dept.

29 West 39th St., New York 18, N. Y.

LEFAX POCKET SIZE TECHNICAL DATA BOOKS $1. EACH

Printed on loose leaf, six hole 6¾" x 3¾" bond paper, each book contains about 140 pages of technical data, presenting condensed, accurate and essential data for the student, engineer, technical worker and business man.

Architecture	Metals	Transformers,	Analytic
Home Heating	Gen'l Chemistry	Relays, Meters	Chemistry
Illumination	Reinf. Concrete	Hydraulics	Highway
Electrician's Data	Building Constr.	Surveying	Engineering
Builder's Data	Radio	Mech. Drawing	Pwr. Trans. Mach'y
Lumber Data	Television & FM	Machine Design	Thermodyn. Tbls.
Air Conditioning	Electricity, AC	Machinists Data	& Charts
General Math.	Electricity, DC	Piping Data	Phys. & Thermodyn.
Math. Tables	AC motors and	Surveying Tables	Data
Physics	Generators	Trig-Log Tables	Phys. & Org. Chemistry
Chemical Tables		Metallurgy	

Write for FREE Catalog, over 2000 listings. See for yourself how helpful LEFAX can be to you. Send $1. for each book, or $5. for any six books listed above, to:

LEFAX Dept. ME-10 Philadelphia 7, Pa.

This kind of compactness

· Saves Space · Reduces Costs · Increases Efficiency

Many existing products, like heat exchangers, evaporators and condensers, can now be redesigned to smaller dimensions, thereby saving valuable space without affecting their present operating efficiency (as a matter of fact, some have increased their efficiency) by using Wolverine Trufin*—the integral finned tube.

Engineers see the new opportunities it gives them to design their products with more compactness—and even streamlining.

Trufin is available in many metals: copper, aluminum, copper base alloys, steel, etc.—in a variety of fin spacings, fin heights, and sizes. Trufin is also available in bi-metal.

It can be fabricated or formed as easily as plain tube. Since the tube is all one piece the fins are not affected by vibrations or sudden temperature changes.

You should be interested in learning more about this unique finned tube. Write for our new brochure that gives you full description.

*REG. U. S. PAT. OFF.

Wolverine Trufin and the Wolverine Spun End Process
available in Canada through the Unifin Tube Co., London, Ontario.

PERFORMANCE IS GREAT— MAINTENANCE IS EASY... WHEN YOUR PUMP IS A PEERLESS *Fluidyne*

WIDEST RANGE OF SIZES, CAPACITIES AND HEADS—

¼ to 150 HP
10 to 5500 GPM

PEERLESS PUMPS

Choose Your Pump
FROM THE FLUIDYNE LINE

It's one of the broadest and most complete lines of horizontal end-suction general purpose pumps offered by any manufacturer. Two types are available, fitting most all piping and pumping layouts, as well as system sub-assemblies. Peerless Type PE is a close-coupled electric drive, using standard pump motors. Type PB is adaptable to flexible-coupled or belt-drive. Both types provide excellent efficiencies. They are compact, dependable, economical and durable. Maintenance is easy because Peerless design and construction are so simple. Apply them whenever you need an economical general purpose water handling pump.

CHARACTERISTICS AT A GLANCE
CAPACITIES AND HEADS

TYPE PE Close-coupled—¼ to 40 hp
Up to 65 gpm fractional hp sizes
Up to 1000 gpm integral hp sizes
Up to 110 ft. fractional hp sizes
Up to 200 ft. integral hp sizes

TYPE PB Flexible-coupled—¼ to 150 hp
Up to 50 gpm fractional hp sizes
Up to 5500 gpm integral hp sizes
Up to 90 ft. fractional hp sizes
Up to 260 ft. integral hp sizes

♦ ***NEW BULLETIN*** *describes all the features of pumps in the Peerless Fluidyne line. Write for your copy of this profusely illustrated and detailed engineering bulletin today.*

MAIL COUPON TODAY

fmc PEERLESS PUMPS

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Los Angeles 31, California

Please send me a copy of Peerless Fluidyne Pump Bulletin No. B-2300.

NAME_____
COMPANY_____
STREET_____
CITY_____ STATE_____
ME

PEERLESS BUILDS DEPENDABLE PUMPS

DOES YOUR PROBLEM INVOLVE.... ?

Corrosion Resistance
Strength in Tension and Compression
Hardness & Toughness
Pressure-Tightness
Resistance to Erosion
Resistance to Frictional Wear
Fatigue Resistance

... if so CONSULT US

Most certainly there is one of "our own alloys," or one of the many non-ferrous alloys we make that will meet your exact requirements—At any rate, our long and varied experience as Metallurgical Engineers and Founders is at *your service* for any problem or product you may have.

Please send me a copy of your latest "Reference Book of Bronze Casting Alloys."

AMERICAN MANGANESE BRONZE COMPANY

4703 Rhawn St., Holmesburg, Philadelphia 36, Pa.

Established 1909

MECHANICAL ENGINEERING
October, 1952 CARD INDEX Vol. 74, No. 10

Engineering in Management, J. G. Pleasants	781
Technology in a Troubled World, W. C. Foster	784
Plywood is Engineered Wood, T. D. Perry	787
Modern High-Pressure High-Temperature Boilers—1, G. W. Kessler	797
Modern Machine-Tool Lubrication Practice, W. D. Whalen	803
Analysis of Developments in Automation, C. J. Jacoby, 3rd	810
The Romance of Power and Fuels, J. E. Tobey	812
Editorial	779
Briefing the Record	816
ASME Technical Digest	829
Contents of ASME Transactions	836
Comments on Paper	837
Books Received in Library	840
ASME News	841
ASME Junior Forum	857
Engineering Societies Personnel Service	858

ASBESTOS PROTECTED

... to prevent failure of windings

US MOTORS

Write for bulletin

U.S. ELECTRICAL MOTORS Inc.
Los Angeles 54, Calif. (Box 2058) • Milford, Conn.

Cut Testing Time with G-E Two-scale Hand Pyrometer

Simply flick a switch to change to either the 0–500 F or 0–1500 F scale ranges of the General Electric Type FH-1 hand pyrometer. This unique feature of the FH-1 cuts testing time and eliminates the use of several pyrometers.

The Type FH-1 hand pyrometer is designed for rapid and convenient measurement of surface, liquid, and gas temperatures. Even molten-metal temperatures can be obtained.

AUTOMATICALLY COMPENSATED

Readings can be made directly for either scale of the instrument. Because of automatic cold-end compensation, the FH-1 needs no manual adjustment for variations in temperature in either the instrument or surrounding atmosphere.

THREE INTERCHANGEABLE TIPS

A surface tip, an immersion tip for liquids and molten metals, and a 2-prong contact tip can be supplied with the FH-1. A carrying case and both flexible and rigid arms are also available.

LOW PRICE

The price of the FH-1 as shown including the instrument, rigid extension arm, and surface tip is only $112.12*. For more information check bulletin request coupon for GEC-836.

Thermocouple Vacuum Gages Aid Laboratory Glass-to-metal Sealing

To aid in obtaining the vacuum necessary in one process of sealing glass to metal, the General Electric Research Laboratory uses three G-E thermocouple vacuum gages. Pressures at various points in the vacuum system are measured by using a number of tubes installed in desired locations.

WIDE APPLICATION

The vacuum gage is sensitive to both condensable and non-condensable gases, and has ranges of from 1 to 200 and from 1 to 500 microns of mercury. It can measure pressures in many manufacturing and chemical processes, and is especially valuable for checking pressures for vacuum-tube evacuation, vacuum dehydration, vacuum-heat treatment of metals, metalizing, and vacuum processing of vitamins.

THREE STYLES

Three different mountings are offered: portable-case style, relay-rack type, and panel type. Price for the portable type is $117.58*. Check Bulletin GEC-385 for more information on these gages.

G-E Insulation-resistance Meter Cuts Rejections Due to Insulation Failure

REDUCTION OF REJECTS due to insulation failure is easily accomplished with a General Electric insulation-resistance meter.

SAFER TO OPERATE

Safer to operate, the maximum output current being limited to two milliamperes, the meter can be used wherever 115-volt, 50- or 60-cycle power is available. The meter measures insulating-resistance over a range of 0-20,000 megohms, and is extremely valuable in detecting faults during the manufacture of electrical equipment.

EASY TO USE

The G-E insulation-resistance meter is small, compact, portable—thus convenient for production and service testing. Operated by one person, the meter is simple to use. Price: $304.20*. Write for Bulletin GEC-753. General Electric Co., Schenectady 5, New York.

*Manufacturer's Suggested Retail Price.

SECTION B605-25, GENERAL ELECTRIC
SCHENECTADY 5, N. Y.

Please send me the following bulletins:
Indicate:
√ for reference only
X for planning an immediate project

- ☐ Thermocouple Vacuum Gages (GEC-385)
- ☐ Insulation-resistance Meter (GEC-753)
- ☐ Hand Pyrometer (GEC-836)
- ☐ 1952 Catalog (GEC-1016)

NAME .....
COMPANY .....
STREET .....
CITY ..... ZONE ..... STATE .....

GENERAL ELECTRIC

LENAPE
STUDDING OUTLETS
offer many advantages

Curved Studding Outlets or Pads in ASA sizes and standards provide reinforcement of the shell opening. Studding outlets, naturally short in height and providing reinforcement of the opening, have design appeal, economy in price and fabrication, and advantages in use.

Important applications include interdeck access openings on small diameter towers or columns, boiler mountings, clean-out or observation ports, and similar uses in close-clearance locations.

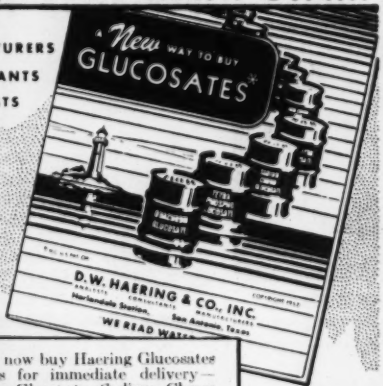
Sizes 16" and larger (even to 30" I.D.) are ideal access openings and in 18" and 20" sizes are the most modern and economical manway for LPG tanks.

LENAPE HYDRAULIC PRESSING AND FORGING CO.

LENAPE HYDRAULIC PRESSING & FORGING CO.
DEPT. 106 WEST CHESTER, PA.
RED MAN PRODUCTS

Send for this Valuable Booklet

MANUFACTURERS • CONSULTANTS • ANALYSTS

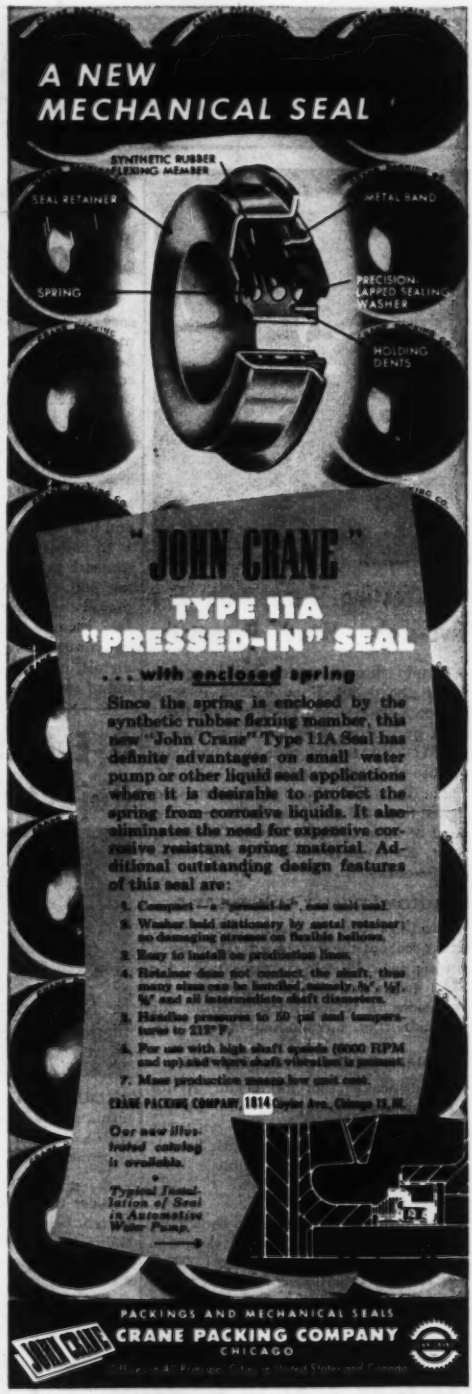


You can now buy Haering Glucosates in drums for immediate delivery—Quachrom Glucosate, Sodium Chrom Glucosate, Tetra Phospho Glucosate and all the 11 specialized Glucosates for control of Scale, Corrosion and Algae.

Send for this new book on your company letterhead today! It will save you time and money.

WE READ WATER M-O-M ESTABLISHED 1931

D. W. HAERING & CO., INC.
GENERAL OFFICES
Harlandale Station, San Antonio, Texas


A NEW MECHANICAL SEAL
SYNTHETIC RUBBER FLEXING MEMBER
SEAL RETAINER
METAL BAND
SPRING
PRECISION LAPPED SEALING WASHER
HOLDING DENTS
"JOHN CRANE"
TYPE 11A
"PRESSED-IN" SEAL
. . . with enclosed spring
Since the spring is enclosed by the synthetic rubber flexing member, this new "John Crane" Type 11A Seal has definite advantages on small water pump or other liquid seal applications where it is desirable to protect the spring from corrosive liquids. It also eliminates the need for expensive corrosive resistant spring material. Additional outstanding design features of this seal are:
1. Compact—a "complete" one unit seal.
2. Washer held stationary by metal retainer; no damaging stresses on flexible bellows.
3. Easy to install on production lines.
4. Retainer does not contact the shaft, thus many sizes can be handled, namely, ⅝", ¾", ⅞" and all intermediate shaft diameters.
5. Handles pressures to 50 psi and temperatures to 212° F.
6. For use with high shaft speeds (6000 RPM and up) and where shaft vibration is present.
7. Mass production means low unit cost.
CRANE PACKING COMPANY, 1814 Cuyler Ave., Chicago 13, Ill.
Our new illustrated catalog is available.
Typical Installation of Seal in Automotive Water Pump.
PACKINGS AND MECHANICAL SEALS
CRANE PACKING COMPANY
CHICAGO

Check List

for selecting a Piping Contractor

Listed below are a number of important factors that should be taken into account whenever you select a piping contractor. If any of these are overlooked, you are not buying your piping construction to best advantage.

☐ **EXTENSIVE SIMILAR EXPERIENCE** • Is the contractor thoroughly experienced on your type of work? Problems are always more readily solved when they have been met before.

☐ **MODERN FABRICATING PLANTS** • Fully equipped plants staffed by piping experts mean practical piping subassemblies that are correctly planned and prefabricated to simplify and expedite field erection.

☐ **PROGRESSIVE ORGANIZATION** • You want a contractor who keeps abreast of new piping developments. Piping research on a continuous basis should be his policy.

☐ **CONVENIENT LOCATION** • A fabricating plant near enough to give you quick service is of prime importance. Convenient location also improves overall supervision of the job.

☐ **SUPERIOR FIELD FACILITIES** • A job of any size needs a resident superintendent with a permanent staff of supervising erectors. Welders should be qualified on your materials.

☑ **PLUS SERVICES** • The experienced contractor often can make suggestions that result in improved piping design and savings in time and money.

4596

You can check all these when you select MIDWEST

MIDWEST PIPING SERVICE IS NATION-WIDE

4 Plants Are Better Than 1

PIPING FABRICATORS AND CONTRACTORS

MIDWEST PIPING & SUPPLY CO., INC.
Main Office: 1450 South Second Street, St. Louis 4, Mo
Plants: St. Louis, Passaic, Los Angeles and Boston
Sales Offices: New York 7—50 Church St. • Chicago 3—79 West Monroe St.
Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.
Tulsa 3—224 Wright Bldg. • Boston 27—436 First St.

Representatives—Sales Agencies Business for Sale Partnership—Capital Manufacturing Facilities

OPPORTUNITIES

Positions Open—Positions Wanted—Equipment, Material, Patents, Books, Instruments, etc. Wanted and For Sale

Answers to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

POSITIONS OPEN

ENGINEERS INSTRUMENT

Expanding Chicago concern in coordinated process control field offers permanent and interesting positions with unusual opportunity for advancement. Require chemical, electrical or mechanical graduates to handle design, application, contract or production engineering on prefabricated control panels for the process industries and utilities. Experience in allied work desirable.

PANELLIT, INC.
6312 No. Broadway
Chicago 40, Ill.

DEVELOPMENT ENGINEER

Graduate mechanical or electrical engineer, experienced, for research and development in application of electrical, pneumatic, hydraulic controls and measuring devices to fluid flow and chemical processes. Permanent position in growing industry located in Tucson, Arizona. Ideal climate and excellent working conditions in new plant. Write giving full details including salary requirements.

Address CA-4069, % "Mechanical Engineering."

MECHANICAL ENGINEER

Experienced or interested in

MACHINE DESIGN

Permanent position for graduate, age 28–50. Previous experience in excavator design desirable but not a must.

Company is small but progressive and is presently expanding production facilities. Sales volume $8,000,000 per year, Dunn and Bradstreet AA1, approximately 800 employees including steel foundry. Population of Marion, Ohio, about 37,000. Product—excavators 1/2 yard to 2-1/2 yard.

Applicant must be board designer well grounded in engineering mechanics and machinery layout. Salary open. Write or apply giving complete qualifications and references. Your reply will be held confidential.

THE OSGOOD COMPANY
CHENEY AVENUE
MARION, OHIO
ATTN: J. E. Calloselle, Chief Engr.

RATES Classified Advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $1.70 a line. $1.35 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display Advertisements carried in single column units of multiples of one inch at flat rate of $98 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication.

MECHANICAL OR AUTOMOTIVE ENGINEER

Large research and engineering laboratory needs an engineer to assist in the planning and carrying out of methods and procedures for classifying, indexing, and disseminating technical information resulting from the Company's research program. Qualifications required are a Bachelor's Degree in Mechanical or Automotive Engineering, plus an interest in and aptitude for technical literature work. Some experience desirable but not essential. Ethyl Corporation, 1600 West Eight Mile Road, Ferndale 20, Detroit, Michigan.

mechanical superintendent

Experienced Mechanical Inspector to supervise installation of Mechanical equipment for Steam Electric power plant construction. Salary open.
KINDLY SUBMIT COMPLETE RESUMÉ.
Address CA-4058, % "Mechanical Engineering."

MECHANICAL ENGINEER

Responsible permanent position in new section of established company.

Graduate, age 35-50, experienced in chemical industry design including pressure vessels, piping, materials and specifications.

Paid holidays, paid vacation, low cost group health, accident and life insurance, retirement plan.

Salary commensurate with ability and experience.

Submit resumé of personal history, education, experience, salary expected.

Application confidential.

DIRECTOR OF DEVELOPMENT
NITROGEN DIVISION
ALLIED CHEMICAL & DYE CORP.
ORGANIC DEPARTMENT
HOPEWELL, VIRGINIA

Bearing and Lubrication Engineer

With a minimum of several years' experience in the theory and application of bearings and lubricants, for PERMANENT position with INTERNATIONAL BUSINESS MACHINES, Endicott, New York.

Should have an engineering degree or equivalent and experience in porous metal sleeve bearings, ball and roller bearings and lubricants as used in intricate high speed electro-mechanical devices.

Excellent living and working conditions, good salary, exceptional employee benefits, opportunity for professional development, moving expenses paid.

Write, giving full details including education and experience, to: Mr. E. H. Getkin, Coordinator of Engineering Recruitment, International Business Machines, Department 686 (5), 590 Madison Ave., New York 22, N. Y.

***READ the* CLASSIFIED ADVERTISEMENTS**
appearing in this section each month.

Excellent Opportunity
Engineers
Chemical, Mechanical, Electrical
for
Sales
Estimating
Design
Process Development
Fast Growing
Medium Size Company
Major Chemical Process Equipment

Air Products, Inc.
P O Box 538
Allentown, Penna.

MECHANICAL ENGINEER

Established consulting firm, New York area, desires Mechanical Engineer, capable supervising starting, testing, operating and correcting troubles of steam-electric station equipment. Plant betterment work involving considerable travelling. Technical education, and plant operating or betterment experience required. State education, experience and salary desired.

Address CA-4097, % "Mechanical Engineering."

ENGINEER

With technical education and ten to fifteen years of experience in design and development of heavy machinery or similar experience, for research and development work both as to design and from industry study points of view. Permanent position with opportunities to grow are involved in expanded program of well-established heavy machinery, rolling mill and hydraulic press builders. Location Pittsburgh. Write complete details of experience pertinent personal information, and enclose photograph in first letter. Salary $7,000 to $9,000 per year, depending upon experience.

Address CA-4070, % "Mechanical Engineering."

MECHANICAL ENGINEER

We need one experienced BS or MS Mechanical Engineer for design, construction and maintenance work in connection with bench scale and pilot plant research in coal processing. This position offers an exceptional opportunity for advancement both in research and in anticipated commercial fields. Replies including educational experience, references, salary desired and recent photograph should be directed to:

Pittsburgh Consolidation Coal Company
Research and Development Division
Library, Pennsylvania
Attention: William F. Saalbach
Adviser on Personnel

It will pay you to watch the announcements on these pages for an opportunity that you may be looking for or one that may be of interest to you.

ME... an AIRCRAFT ENGINEER... in CALIFORNIA?

Yes, Lockheed can train you—at full pay!

The step up to Aircraft Engineering—and a better life in Southern California—isn't as steep as you might expect.

Aircraft Experience isn't necessary. Lockheed takes your knowledge of engineering principles, your experience in other engineering fields, your aptitude, and adapts them to aircraft work. You learn to work with closer tolerances, you become more weight conscious.

What's more, Lockheed trains you *at full pay*. You learn by doing—in Lockheed's on-the-job training program. When necessary, you attend Lockheed classes. It depends on your background and the job you are assigned. But, always, you learn at full pay.

These opportunities for engineers *in all fields* have been created by Lockheed's long-range production program—building planes for defense, planes for the world's airlines.

And remember this: When you join Lockheed, your way of life improves as well as your work.

Living conditions are better in Southern California. The climate is beyond compare: Golf, fishing, motoring, patio life at home can be yours the year 'round. And your high Lockheed salary enables you to enjoy life to the full.

Note to Men with Families: Housing conditions are excellent in the Los Angeles area. More than 45,000 rental units are available. Thousands of homes for ownership have been built since World War II. Huge tracts are under construction near Lockheed.

Send today for illustrated brochure describing life and work at Lockheed in Southern California. Use handy coupon below.

ENGINEER TRAINING PROGRAM
M. V. Mattson, Employment Mgr., Dept. ME-11

LOCKHEED
Aircraft Corporation
Burbank, California

Dear Sir: Please send me your brochure describing life and work at Lockheed.

My Name _____

My Field of Engineering _____

My Street Address _____

My City and State _____

Aerophysicists, Designers, Engineers

YOUR IDEAS WILL COUNT AT NORTH AMERICAN

North American encourages advanced thinking, because they know looking ahead is the only way to maintain leadership in the aviation industry. That's why North American needs men of vision. If you like hard thinking and would like to work for a company that will make the most of your ideas, you'll find real career opportunities at North American. North American offers you many extra benefits, too.

North American Extras—

Salaries commensurate with ability and experience • Paid vacations • A growing organization • Complete employee service program • Cost of living bonuses • Six paid holidays a year • Finest facilities and equipment • Excellent opportunities for advancement • Group insurance including family plan • Paid sick leave • Transportation and moving allowances • Education refund program • Low-cost group health (including family) and accident and life insurance • A company 24 years young.

Write Today

Please write us for complete information on career opportunities at North American. Include a summary of your education, background and experience.

IS YOUR FIELD LISTED HERE?

Airborne Electronic Equipment
Equipment Flight Tests
Precision Instruments
Automatic Controls
Propulsion Systems
Servo-Mechanisms
Airframe Studies
Radar Devices
Instrumentation
Micro Wave Techniques
Metallurgical
Electroplating
Engineering Planning

NORTH AMERICAN AVIATION, INC.

Aerophysics, Electro-Mechanical Research Division

Dept. 6, Personnel Section,

12214 Lakewood Blvd., Downey, California

North American Has Built More Airplanes Than Any Other Company In The World

Eight Pages of "OPPORTUNITIES"

A young, aggressive, employee-owned, and leading manufacturer of Controlled Volume Pumps needs the following permanent personnel for an expansion program.

MACHINE DESIGNER SENIOR AND JUNIOR
Engineering graduate with 5 to 10 years' machine design experience, capable of initiating original designs and detailing for shop manufacture.

INSTRUMENT ENGINEER
Engineering graduate with 5 to 10 years' experience in varied application work. Requires a knowledge of electronic, chemical and mechanical controls to be applied to our product. Will be required to make sketches and shop layouts.

EMPLOYEE BENEFITS

OPPORTUNITY

GOOD EARNINGS

PROFIT SHARING AND PENSION PLAN

SUBURBAN LOCATION

OTHER BENEFITS

Give full information and salary desired to

MILTON ROY COMPANY

1200 E. Mermaid Lane
Philadelphia 18, Pa.

TECHNICAL PERSONNEL

looking for
INCREASED RESPONSIBILITY
in

ENGINEERING
- PRODUCTION
- MAINTENANCE
- INSTRUMENTATION
- CONSTRUCTION LIAISON
- INDUSTRIAL ENGINEERING
- DESIGN AND DEVELOPMENT
- ARCHITECT-ENGINEER LIAISON

LIBRARY SCIENCE
MATHEMATICS
STATISTICS
METALLURGY

investigate opportunities at our

ATOMIC ENERGY INSTALLATIONS

Send resume and request for detailed information concerning Openings, Company Policies and Community Life

TECHNICAL PERSONNEL OFFICE

CARBIDE AND CARBON CHEMICALS COMPANY

a division of

UNION CARBIDE AND CARBON CORPORATION

POST OFFICE BOX P, OAK RIDGE, TENN.

Eight Pages of "OPPORTUNITIES"

DESIGN ENGINEERS
DRAFTSMEN
CHECKERS

Capable men for Designing, Layout, Drafting and ability to handle details and work to standards required. Excellent opportunity in each position. Phone or write so that interview arrangements may be made.

Personnel Manager
EDWARD VALVES, INC.
1200 West 145th St.
Essex 5-1235 East Chicago, Indiana
East Chicago 231

Research Engineer

To assume responsible charge of a program investigating the problem of combustion stability as applied to large scale liquid rocket vehicles. Background in fluid mechanics, vibration and combustion essential. Working knowledge of instrumentation and servo-mechanics desirable. Minimum training of M. S. in M. E. or Ch. E. required. Apply giving details pertaining to academic background and work experience to:

California Institute of Technology
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena 3, California

AC SPARK PLUG DIVISION OF GENERAL MOTORS CORPORATION

PRECISION INSTRUMENT PLANT

Positions now available for highest caliber personnel in the field of airborne automatic electro-mechanical control equipment.

MECHANICAL DESIGN ENGINEERS
ELECTRONIC ENGINEERS
SERVO ENGINEERS
ELECTRONIC DESIGNERS
MECHANICAL DESIGNERS

New and expanding division of an established firm with 20 years of successful experience in the instrument field. Work involved deals with the manufacture and development of highly complex equipment of the most advanced type.

Write or Apply

AC Spark Plug Division
General Motors Corporation
1925 E. Kenilworth Place
Milwaukee 2, Wisconsin

WANTED — CHIEF ENGINEER

For medium-size, well established St. Louis precision machine tool manufacturer, to direct and coordinate product design. Exceptional opportunity to grow with progressive company. Must have administrative ability and practical judgment. Knowledge of tooling desirable. Prefer graduate engineer, 35 to 45. Include educational, practical and administrative experience with personal data in first letter. All replies confidential.

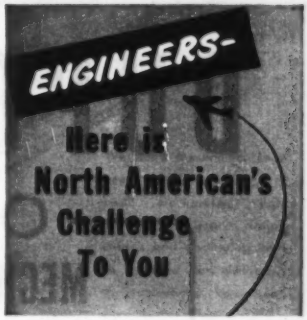
Address CA-4085, care of "Mechanical Engineering."

TO YOUNG ENGINEERS INTERESTED IN:

1. POWER AND PROCESS INSTRUMENTATION
2. HELPING TO MAKE A MEDIUM SIZED COMPANY BIGGER
3. LIVING IN A MIDWESTERN CITY, POPULATION 30,000

Here is an opportunity to make a good salary; to be a part of one of the most exciting industries in the U. S.; to work in an established organization where your technical and personal growth is encouraged; to escape the dirt, pressure, impersonality and commuting of the big city and live in a small town with excellent educational and recreational facilities for yourself and your family. Send personal resumé to:

Dept. PAS
THE HAYS CORPORATION
Michigan City, Indiana



Frankly, working at North American requires hard thinking and plenty of vision. Because North American always works in the future. Yet, if you are interested in advanced thinking, if you'd like to work on the planes that will make tomorrow's aviation history, you'll like working at North American. North American offers these extra benefits, too.

North American Extras—

Salaries commensurate with ability and experience • Paid vacations • A growing organization • Complete employee service program • Cost of living bonuses • Six paid holidays a year • Finest facilities and equipment • Excellent opportunities for advancement • Group insurance including family plan • Paid sick leave • Transportation and moving allowances • Educational refund program • Low-cost group health (including family) and accident and life insurance • A company 24 years young.

Write Today

Please write us for complete information on career opportunities at North American. Include a summary of your education, background and experience.

CHECK THESE OPPORTUNITIES AT *North American*

- **Aerodynamicists**
- **Stress Engineers**
- **Aircraft Designers and Draftsmen**
- **Specialists in all fields of aircraft engineering**
- **Recent engineering graduates**
- **Engineers with skills adaptable to aircraft engineering**

NORTH AMERICAN AVIATION, INC.

Dept. 6, Engineering Personnel Office
Los Angeles International Airport
Los Angeles 45, Calif.; Columbus 16, Ohio

North American Has Built More Airplanes Than Any Other Company In The World

DUPONT

Offers MECHANICAL ENGINEERS

Responsible Field Engineering Positions on

The Savannah River Project

• a Billion Dollar Atomic Materials Plant for the U. S. Atomic Energy Commission.

Minimum qualifications for the openings are a B.S. Degree and considerable PROCESS PIPING INSTALLATION EXPERIENCE.

To well qualified engineers who are interested, we invite your consideration of the following advantages—

★ **Association With an Outstanding Engineering Group**

★ **Opportunity to Add a Great Experience to Your Professional Career**

★ **54 Hr-Week With Overtime Pay**

★ **Housing Assistance & Excellent Employee Industrial Relations Plan**

FOR FURTHER INFORMATION

Kindly Wire, Telephone or Send Us Your Name and Address

E. I. du Pont de Nemours & Co., Inc.

Construction Recruitment Section

P. O. Box 117 Augusta, Ga.

MECHANICAL ENGINEER

Large synthetic yarn plant has opening for Mechanical Engineer graduate in the 23-30 age bracket. Prefer two to three years' drafting experience, preferably in Textile Machinery design. Submit detailed resumé with salary requirements.

Address CA-4094, % "Mechanical Engineering."

CHEMIST

Chemist experienced analyzing power plant problems, capable prescribing water treatment methods and writing equipment specifications, training and supervising plant chemists and operators. State education, experience, salary desired.

Address CA-4096, % "Mechanical Engineering."

Would you like to live in a small town, within easy access of several large cities, right in the lake region of lower Michigan?

We are interested in electrical and mechanical engineers for both laboratory and design work on motors and other products. There is also an opening for a good career draftsman. This is a normal expansion program, not a defense boom. Write fully about yourself.

Address:
R. P. Ballou, Chief Engineer
Howell Electric Motors Company
Howell, Michigan

Additional Opportunities are offered in the display advertisements— on pages 50, 67, 68, 120, 134, 146

MECHANICAL ENGINEERS

Hydroelectric power plant design. Piping, mechanical equipment selection and specification writing. Permanent positions—Chicago office. Salary commensurate with experience. Write giving full experience record and qualifications.

HARZA ENGINEERING COMPANY
400 West Madison Street
Chicago 6, Illinois

The Tennessee Valley Authority wants Mechanical Engineers to assist in the design, construction, and operation of large steam electric and hydroelectric projects and transmission systems. Salaries start at $3700, $4450, and $5325 for 40-hour week. All jobs carry automatic within-grade increases for satisfactory service, liberal vacation leave, sick leave, and retirement benefits. Design jobs are in Knoxville and Chattanooga, Tennessee. Field construction and operations jobs are at various sites in the Tennessee Valley area and at Paducah, Kentucky. Write the

TENNESSEE VALLEY AUTHORITY

Division of Personnel
Knoxville, Tennessee

ENGINEERS AND PHYSICISTS BS-MS-PH.D.

Responsible positions in mechanical, electrical or electronic engineering, physics or engineering physics for advanced development and design of special equipment and instruments. Prefer men with minimum of two years' experience in experimental research design and development of equipment, instruments, intricate mechanisms, electronic apparatus, optical equipment, servomechanisms, control devices and allied subjects. Positions are of immediate and permanent importance to our operations. Southwestern location in medium sized community. Excellent employee benefits. Reply by letter giving age, experience and other qualifications. All applications carefully considered and kept strictly confidential. Ind. Rel. Manager, Research & Development Dept.,

PHILLIPS PETROLEUM COMPANY

Bartlesville, Oklahoma

MECHANICAL ENGINEERS

BENDIX RADIO will suit you to a "T"

We need Mechanical Engineers to work on design of small mechanisms, light structures, gear trains, chassis and packaging units as applied to electronics communications equipment.

Men we want must have M. E. or A. E. degree, with one or more years experience in mechanical design.

Positions involve board design, model shop association and construction-testing of primary models.

You benefit from excellent starting salary, ideal working conditions in modern plant, paid vacations and holidays and good chance for rapid advancement. Housing immediately available in beautiful suburban and country areas that surround the Bendix plant.

Write, wire or phone
MR. E. O. COLE, Dept. M

Bendix Radio
DIVISION OF BENDIX AVIATION CORP.
BALTIMORE-4, MD. Phone: TOWSON 2200

Mechanical Designers Layout Draftsmen

For PERMANENT POSITIONS with

Endicott, N. Y. **IBM** *Poughkeepsie, N. Y.*

Excellent opportunities for designers and layout draftsmen with a minimum of five years' experience desirable in mechanism design. Assignments involve the design and layout of intricate high speed mechanisms and electro-mechanical devices at both the development and production engineering level.

Good salaries, unusual opportunities for professional development, exceptional employee benefits, excellent working and living conditions, moving expenses paid.

Write, giving full details, including experience and training, to: Mr. E. H. Getkin, Coordinator of Engineering Recruitment, International Business Machines, Dept. 686 (5), 590 Madison Avenue, New York 22, N. Y.

ENGINEERS

FOR ATOMIC WEAPONS INSTALLATION

Mechanical Engineers, Electronics and Electrical Engineers, Physicists, Aerodynamicists, and Mathematicians. A variety of positions in research and development open for men with Bachelors or advanced degrees with or without applicable experience.

These are permanent positions with Sandia Corporation, a subsidiary of the Western Electric Company, which operates the Laboratory under contract with the Atomic Energy Commission. The Laboratory offers excellent working conditions and liberal employee benefits, including paid vacations, sickness benefits, group life insurance and a contributory retirement plan.

LOCATE IN THE

Healthful Southwest

Albuquerque, center of a metropolitan area of 150,000, is located in the Rio Grande Valley, one mile above sea level. Albuquerque lies at the foot of the Sandia Mountains which rise to 11,000 feet. Cosmopolitan shopping centers, scenic beauty, historic interest, year 'round sports, and sunny, mild, dry climate make Albuquerque an ideal home. New residents experience little difficulty in obtaining adequate housing in the Albuquerque area.

THIS IS NOT A
CIVIL SERVICE APPOINTMENT

Make Application to the
PROFESSIONAL EMPLOYMENT DIVISION

SANDIA *Corporation*

SANDIA BASE
ALBUQUERQUE, N. M.

MAJOR APPLIANCES

PRODUCT DESIGN AND PRODUCT DEVELOPMENT MEN

General Electric Co.

We want capable men with several years of strong experience, who have proven their ability in our field or in similar lines. Appliance Park, Louisville, Kentucky will be the appliance center of the world and our rapid expansion here will provide wide open opportunity for many people in these positions.

Send resume to:

M. B. TRACY
GENERAL ELECTRIC CO.
310 W. LIBERTY STREET
LOUISVILLE 2, KY.

"OPPORTUNITIES" Section This Month 158-165

POSITIONS OPEN

Continued from Page 164

MECHANICAL ENGINEER

Leading firm of Engineers, Designers and Construction require mechanical engineer having some experience with steam-electric central station design with specific and thorough experience on all phases of coal handling systems including unloading from rail or water, conveying, crushing, screening, distribution and sampling. Require general knowledge of capabilities and limitations of equipment commercially available. Initial work mainly on coal handling systems but must have ability to develop into well rounded general engineer capable of later handling all phases of central station design. State education, experience and salary desired.

Address CA-4095, % "Mechanical Engineering."

ENGINEERS—for professorships and others, all engineering fields. Positions starting in January, nearly all sections of U. S. Salaries $4200-7000. Send Photo and qualifications. Cline Teacher's Agency, Box 607, East Lansing, Michigan.

MECHANICAL ENGINEER—Position open for Mechanical Engineer with Eastern Freight Car Manufacturer. Administrative ability and experience in freight car design required. Will lead to full charge of Engineering Department of 25 employees. Age 35-45. Salary open. Send resumé to Bauer Advertising, Inc., 50 Church Street, New York 7, N. Y.

MECHANICAL ENGINEERS—STRESS ANALYSTS—HYDRAULIC AND SERVO SPECIALISTS—Research positions available with large machine tool company in an expanding research program. Engineers with expert experience in hydraulic control systems, servomechanisms and stress analysis needed. Individuals with aircraft design experience are particularly invited to explore the possibilities offered by these positions. Engineers with a sincere interest in making basic contributions to industrial productivity through a basic industry will find challenge and unusual opportunity here. Address CA-4073, care of "Mechanical Engineering."

METAL CUTTING RESEARCH—Mechanical Engineers and Physicists needed by large machine tool company for expanding program of basic and applied research on metal cutting, and on the grinding of metals treated as a metal cutting process. Here is an opportunity for original research in a virtually virgin field with a company well known for its research contributions to this field. These positions offer unusual opportunity and challenge to individuals with a sincre interest in developing and applying new knowledge of a type that will benefit industry as a whole. Address CA-4074, care of "Mechanical Engineering."

JUNIOR MECHANICAL ENGINEER—The University of Illinois is in need of a University graduate with a degree in Mechanical Engineering who is interested in maintenance, operation, and design. Good starting salary, full employee benefits, including educational opportunities. Address CA-4101, care of "Mechanical Engineering."

Excellent Opportunity for MECHANICAL AND LUBRICATION ENGINEER—One who is thoroughly familiar with Ball and Roller Bearings. A college graduate in Mechanical Engineering preferred. At least five years' actual experience in general industry. Willing to travel. Write giving full details and qualifications in first letter. Salary Open. Address CA-4002, care of "Mechanical Engineering."

RESEARCH ENGINEER—interested in design and testing of special mechanisms, electronic instrument specialists, interested in developing new applications of existing oscilloscopic and oscillographic instruments, technical writers, photo retouchers; if interested in joining a small (200 men) growing organization should contact Mr. Charles Ballestero, Supervisor, Mechanical Laboratory, Southwest Research Institute, 8500 Calebra Road, San Antonio, Texas.

MECHANICAL ENGINEER—Qualifications: Mechanical engineer with at least five years' experience in designing chemical process type equipment, with broad background in selection of materials of construction and analysis of stresses in protection and design of pressurized equipment and in fabrication methods and techniques. Experience in maintaining equipment of this type will be beneficial. Should be capable of assuming responsibility for establishing mechanical design practices in the Engineering Division of a large food and chemical processing company and for supervising the work of other engineers needed to carry out such a program. Age: Preferred age range 30 to 40. Salary: Open. Location: Midwest. Requirements: Provide information on experience, education and age in reply. Address CA-4043, care of "Mechanical Engineering."

SALES ENGINEERS—for large industrial instrument manufacturer. Prefer men with special training in electronics and graduates of recognized engineering colleges. Will consider Mechanical and Chemical Engineers. Fine opportunity for young engineers with sales aptitude to connect with one of the fastest growing industrial instrument companies in the United States. Locations: Cleveland, New York, Chicago, and Philadelphia. Address CA-4062, care of "Mechanical Engineering."

DEVELOPMENT ENGINEER—with creative ability and originality to head design group and experimental laboratory for development of new, high-speed automatic equipment, and improvements to existing machinery, for manufacture of matches, woodenware and paper products. Thorough knowledge of modern machine design practice and utilization of present-day engineering materials required. Mechanical Engineering Graduate with technical training and experience preferred. Age 40-45 years. Permanent position; some travel. Salary open. Submit resumé. The Diamond Match Company, Engineering & Mechanical Development Department, P. O. Box 229, Barberton, Ohio.

POSITIONS WANTED

SENIOR ENGINEER—B.S., M.S., has had 12 years of all around experience in instrumentation, servo's, instrument design, electronics and production. Had supervisory and organizational experience in large operation. Eastern location preferred. Address CA-4046, care of "Mechanical Engineering."

MECHANICAL ENGINEER—PE, Age 44, Twelve years machinist and toolmaker, six years engineering teaching, seven years sales engineering, technical consulting, design. Accustomed to responsibility and dealing with people. Thoroughly familiar with light metal manufacturing methods and equipment. Desire responsible sales, service or consulting connection. Address CA-4075, care of "Mechanical Engineering."

MECHANICAL-INDUSTRIAL ENGINEER—30, chemical, aircraft background. Experienced plant and cost controls, statistics, processing equipment, materials handling, packaging, technical writing, sales. Languages: French, German. BA Chemistry, BSME, veteran. Address CA-4077, care of "Mechanical Engineering."

See Advertisements on Preceding Pages

MECHANICAL ENGINEER—Registered P.E., 13 years of well rounded experience in design, development and production of mechanical machinery, proven supervisory ability, thorough familiarity with theoretical and experimental methods in applied mechanics. Desires permanent industrial position as assistant chief engineer, project engineer or equivalent. Minimum salary $9,000. Address CA-4079, care of "Mechanical Engineering."

MECHANICAL ENGINEER—29—BSME, married. Four years' structural design and static test for large aircraft company. Currently studing modern business practices. Seeking work in product design and development. Prefers Eastern location. Address CA-4087, care of "Mechanical Engineering."

MECHANICAL ENGINEER—26—B.S. Degree. 3 years' experience in construction (field work). Contract negotiations, estimating, planning and technical writing. Present salary $5000 per year. Address CA-4099, care of "Mechanical Engineering"

INVENTIONS

WRITE for information about service for selling inventions. Patent Engineering Development Co., 624 Southern Standard Building, Houston, Texas.

EMPLOYMENT AGENCIES AND SERVICE BUREAUS

EXECUTIVES, ENGINEERS, DESIGNERS, SPECIALISTS. Our staff—technical graduates—serving both employer and applicant 20 years—no fee until placed—Bradley Placement Service, 555 Leader Building—Cleveland 14, Ohio.

ENGINEERS AND EXECUTIVES—This confidential service for outstanding men who desire positions paying $5,000 to $40,000 will develop preliminary negotiations with reputable organizations without risk to present position. For complete details, send experience record and expected salary range. Tomsett Associates, 337 Frick Bldg., Pittsburgh 19, Pa.

SALARIED POSITIONS $3,500 to $35,000. We offer the original personal employment service (established 42 years). Procedure of highest ethical standards is individualized to your personal requirements. Identity covered; present position protected. Ask for particulars.

R. W. BIXBY, INC.
115 Dun Bldg. Buffalo 2, N. Y.

SALARIED PERSONNEL $3,000—$25,000

This confidential service, established 1927, is geared to needs of high grade men who seek a change of connection under conditions, assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited.

JIRA THAYER JENNINGS
Dept. J, 241 Orange Street, New Haven, Conn.

REPRESENTATIVES AVAILABLE
REPRESENTATION WANTED
BUSINESS OPPORTUNITIES
MANUFACTURING FACILITIES
EQUIPMENT FOR SALE
EQUIPMENT WANTED
HELP WANTED
POSITIONS WANTED
EMPLOYMENT AGENCIES AND SERVICE BUREAUS

If you desire capital or have it to invest; if you have a patent for sale or development; if you have on hand used machinery for disposal, or if you want such equipment; if you have copies of publications, or a set of drawing instruments to dispose of; if you need help or want a position, in fact, anything to be offered that somebody else may want, or anything wanted that somebody else may have—use a classified advertisement in MECHANICAL ENGINEERING for quick results.

RATES One Inch Card Announcements Inserted at rate of $20.00 each issue, $15.00 per issue on yearly contract.

CONSULTING SERVICE

Manufacturers of Equipment Not Included

BLACK & VEATCH
CONSULTING ENGINEERS
Electricity—Water—Sewage—Industry
Reports, Design, Supervision of Construction
Investigations, Valuation and Rates
4706 Broadway — Kansas City 2, Missouri

The Buljian Corporation
ENGINEERS • CONSTRUCTORS • CONSULTANTS
POWER PLANT SPECIALISTS
UTILITY • INDUSTRIAL • CHEMICAL
1200 N. Broad St., Phila. 21, Pa.

Consult **Z. H. POLACHEK**
Reg. Patent Attorney
1234 Broadway
(at 31st St.) New York 1, N. Y.
Phone LO 5-3088

EHRCO DIE CASTING SERVICE
Engineering Consultation—Die Castings
Equipment—Installation
Die and Product Design
John R. Ehrbar, Pres.
303 Main Street, Stamford, Connecticut
Telephone 3-2308

Research and Development
Product Engineering and Styling
Special Production Machines
"Tech" Manuals prepared for Defense Contractors.
Write for Brochure
MAST DEVELOPMENT CO. Inc
2212 E. 12th Street
Davenport, Iowa

SANDERSON & PORTER
ENGINEERS & CONSTRUCTORS
New York • Chicago • San Francisco

Electrical Testing Laboratories, Inc.
Electrical, mechanical, photometric, radiometric and chemical laboratories, rendering testing, research and associated services, including certification, inspections at factories and field investigations.
2 East End Avenue at 79th St., New York 21

Industrial Power—Surveys & Design
MYERS & ADDINGTON
Consulting Engineers
21 East 40th Street, New York 16, N. Y.
MUrray Hill 6-4630

Power Plants, Structures
Transmission Systems
Design, Supervision, Inspection
Appraisals, Reports
SARGENT & LUNDY
140 S. Dearborn St., Chicago, Ill.

C. M. HATHAWAY
CONSULTING ENGINEER
Project Engineering, Product Development, Production Designs, Laboratory and Shop Facilities for Research, Model Work, and Pilot Manufacturing
1315 S. Clarkson Street — Denver 10, Colorado

WELD TESTING
Qualification of Operators—Supervision
Inspection—Research
NATIONAL WELD TESTING BUREAU
Pittsburgh Testing Laboratory, Pittsburgh, Pa.

J. E. SIRRINE COMPANY
Engineers
Design and Supervision of Steam and Hydro-electric Power Plants, Industrial Plants, Mechanical and Operating Surveys, Appraisals • Plans • Reports
Greenville, South Carolina

JACKSON & MORELAND
ENGINEERS AND CONSULTANTS
Design and Supervision of Construction
Reports—Examinations—Appraisals
Machine Design—Technical Publications
Boston — New York

NUCLEAR DEVELOPMENT ASSOCIATES, Inc.
—NDA—
Consulting Physicists, Mathematicians, and Engineers. Studies in Analytical Engineering and Mathematical Physics
80 Grand Street — White Plains, N. Y.
WHite Plains 8-5800

STANLEY ENGINEERING COMPANY
CONSULTING ENGINEERS
Power Plants
Steam - Diesel - Hydro
Design - Construction - Test - Valuation
Surveys
Hershey Building — Muscatine, Iowa

GEORGE H. KENDALL
Consulting Mechanical Engineer
Cost Reduction Studies: Process of Product Redesign Existing Products for Greater Profit
Trouble Shooting Production, Design, Cost Problems, Specialist Automatic Machinery Processes, Controls, New Developments, Patent Studies, Investigations. New Products & Process Engineering Studies.
P.O. Box 72 (Est. 1923) Tel. Darien 5-1504
Noroton Heights — Darien, Connecticut

DELOS M. PALMER & ASSOCIATES
CONSULTING ENGINEERS
Reg. Mechanical, Electrical & Industrial
Designers of Special Purpose Machines
Product Development
Laboratory and Model Work
4401 Jackman Rd. — Toledo 12, Ohio

DESIGNING ENGINEERING
Machines • Products • Plants
Processes • Production • X-Ray
SAM TOUR & CO., INC.
44 TRINITY PL., N. Y. 6, N. Y.

MECHANICAL ENGINEERING, 29 W. 39th St., New York 18, N. Y.

Additional information is requested on the following advertisements in the November 1952 issue

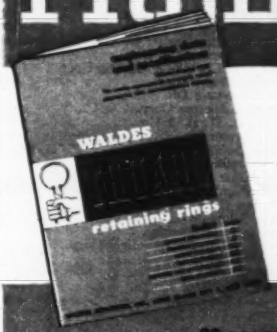
Page No.	*Name of Advertiser*

Name _____ Title _____
Company _____
Address _____
City _____ State _____

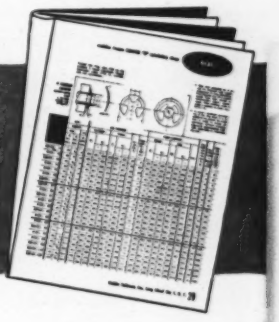
Reader Service Coupon For More Information

Go through the advertising pages and jot down the page numbers and names of advertisers about whose product you want additional information — mail the coupon to us — your request will be passed on to the advertiser promptly — you will hear directly from advertiser — saves your time in writing individual letters.

FREE to every engineer with an industrial fastening problem! The most complete catalog on retaining rings ever published!



This encyclopedia of retaining rings combines—*in one 52 page volume*—engineering specifications and data for 17 different ring types—more than 600 different sizes. Gives assembly data, typical applications, everything you need to know about selection and use of Waldes Truarc Retaining Rings.



28 pages of charts giving complete engineering data and specifications. Dimensions of Rings, Grooves, Shafts, and Housings; Clearances; Allowable Thrust Loads; Safety RPM Limits. Data on end-play take-up. Countless other engineering data, arranged in easy-to-read, easy-to-use table form.

6 pages showing typical cost-cutting applications and case histories, covering self-locking rings; basic type rings; rings for taking up end-play; rings for radial assembly; and special rings.

5 pages showing drawings of assembly and accessory tools, designed to handle Truarc retaining rings on a speedy, production line basis. There are data on tools for recessing grooves, pliers and applicators for assembly, and the new Truarc "E"-ring dispenser. You will find the new Waldes Truarc Retaining Ring Catalog invaluable in selecting and specifying Truarc retaining rings, the better way to hold parts together.

WALDES
TRUARC
REG. U. S. PAT. OFF.
RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,382,947; 2,382,948; 2,416,852; 2,420,921; 2,420,341; 2,439,795; 2,441,848; 2,459,195; 2,483,389; 2,483,393; 2,487,902; 2,487,903; 2,491,398; 2,509,081 AND OTHER PATENTS PENDING.

MAIL THIS COUPON TODAY FOR YOUR COPY!

Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N. Y. ME114

Please send the new complete Waldes Truarc Retaining Ring Catalog. (PLEASE PRINT)

Name_____

Title_____

Company_____

Business Address_____

City_____ Zone_____ State_____

Index To Advertisers

Advance Heating Div. Jensen Specialties (Inc.) 103
*Aetna Ball & Roller Bearing Co. 111
Air Conditioning Exposition 66
*Air Preheater Corp. 119
*Allis-Chalmers Mfg. Co. 88
Aluminum Co. of America 152
*American Blower Corp. 102
*American Brass Co. 39
American Flexible Coupling Co. 57
*American Manganese Bronze Co. 154
*American Pulverizer Co. 58
Amplex Mfg. Co., Div. of Chrysler Corp. 95
*Armstrong Machine Works ..... 3rd Cover
ASME Publications 63, 80, 110
Mechanical Catalog 78
Automotive & Aircraft Div. American Chain & Cable Co. 148
*Babcock & Wilcox Co. ..... 2nd Cover
*Barco Mfg. Co. 62
*Bigelow Co. 61
Bigelow-Liptak Corp. 138
*Blaw-Knox Div., Blaw-Knox Co. 81
Bruning, Charles, Co. 16
Brush Development Co. 3
*Buffalo Forge Co. 22
Buffalo Pump (Inc.) 22
Bundy Tubing Co. 105
Carboloy Dept., General Elect. Co. 10, 11
Carrier Corp. 96
Centriline Corp. 51
Chace, W. M., Co. 79
Chain Belt Co. 114, 115
Chiksan Co. 35
Cincinnati Gear Co. 66
Clarage Fan Co. 170
Clark Equipment Co. Industrial Truck Div. 48
Cleveland Worm & Gear Co. 92
Climax Molybdenum Co. 74
*Cochrane Corp. 28, 29
*Combustion Engineering-Superheater (Inc.) 108
Cone-Drive Gears Div. Michigan Tool Co. 121
Coppus Engineering Corp. 5
*Crane Packing Co. 156
*Denison Engineering Co. 20, 55
*Detroit Stoker Co. 113
Diefendorf Gear Corp. 146
Dow Corning Corp. 46
*Downingtown Iron Works 59
*Dravo Corp., Heating Dept. 125
*Dresser Industries (Inc.) Pacific Pumps (Inc.) 77
Roots-Connersville Blower Div. 65
Dudek & Bock Spring Mfg. Co. 150
DuMont, Allen B., Labs. 34
Earle Gear & Machine Co. 147
Eastman Kodak Co. 106, 107, 139
Edward Valves (Inc.) Sub. Rockwell Mfg. Co. 86, 87
*Elastic Stop Nut Corp. of America 15
Ellison Draft Gage Co. 147

The asterisk indicates that firm also has product catalog in the 1953 ASME Mechanical Catalog and Directory

Fafnir Bearing Co. 97
Fairbanks, Morse & Co. 109, 118
Fenwal (Inc.) 104
Flexo Supply Co. 150
*Foote Bros. Gear & Machine Corp. 141
Ford Instrument Co. Div. of Sperry Corp. 150
*Foxboro Co. 6, 72
*General Electric Co. 116, 117, 155
*Gifford-Wood Co. 12
Graphite Metallizing Corp. 78
*Grinnell Co. (Inc.) 144
Haering, D. W., & Co. 156
Hamilton Mfg. Co. 33
Hankison Corp. 82
Harper, H. M., Co. 100
Hathaway Instrument Co. 56
Heating and Ventilating Exposition 66
Helicoid Gage Div. American Chain & Cable Co. 69
*Heli-Coil Corp. 54
Hirschmann, Carl, Co. 4
Howell Electric Motors Co. 81
Hydropress (Inc.) 129
Insul-Mastic Corp. of America 27
International Nickel Co. 36
Irving Subway Grating Co. 49
*James, D. O., Gear Mfg. Co. 7
Jenkins Bros. 42
*Johns-Manville 135
Johnson, Carlyle, Machine Co. 128
*Keckley, O. C., Co. 56
Kellogg, M. W., Co. 2
Kennedy Valve Mfg. Co. 60
*Kewanee-Ross Corp. 126
*Koppers Co. (Inc.) Fast's Coupling Dept. 17
*Ladish Co. 137
Ledeen Mfg. Co. 68
Lefax 152
Lenape Hydraulic Pressing & Forging Co. 156
*Leslie Co. 32
Lincoln Electric Co. 130
Linear (Inc.) 147
*Link-Belt Co. 142
Little, Arthur D. (Inc.) 23
Loewy Construction Sub. of Hydropress (Inc.) 129
Lord Mfg. Co. 75
Lovejoy Flexible Coupling Co. 146
MB Mfg. Co. 14
Marsh Instrument Co., Affil. Jas. P. Marsh Corp. 21
*Mercoid Corp. 74
Midwest Piping & Supply Co. 157
Murphy, Jas. A. & Co. 82
*National Airoil Burner Co. 74
National Carbon Co. Div. of Union Carbide & Carbon Corp. 145
National Power Show 52
New Departure Div. General Motors Corp. 1
Nicholson, W. H. & Co. 58
Ohio Injector Co. 31
*Oilgear Co. 13
O'Neil-Irwin Mfg. Co. 45
*Pacific Gear & Tool Works 83
Pacific Pumps (Inc.) 77
*Pangborn Corp. 73
Parker White-Metal Co. 30
*Peerless Pump Div. Food Machy. & Chemical Corp. 154
Permutit Co. 112
Power Show 52
Powers Regulator Co. 127
*R-S Products Corp. 93
*Read Standard Corp. 70
Reeves Pulley Co. 53
Reliance Electric & Engrg. Co. 18, 19
Reliance Gauge Column Co. 76
Revere Copper & Brass (Inc.) 101
Ric-Wil Co. 71
Rockford Clutch Div., Borg-Warner 148
Rockwell Mfg. Co. Nordstrom Valve Div. 123, 124
*Roots-Connersville Blower Div., Dresser Industries (Inc.) 65
*SKF Industries (Inc.) 8, 9
*Sarco Co. 169
*Schutte & Koerting Co. 151
Servel (Inc.) 91
*Sier-Bath Gear & Pump Co. 64
Sponge Rubber Products Co. 94
*Taylor Forge & Pipe Works 143
*Taylor Instrument Cos. 98, 99
*Terry Steam Turbine Co. 26
Thomas Flexible Coupling Co. 49
*Timken Roller Bearing Co. ..... 4th Cover
Trane Co. 136
Trimount Instrument Co. 148
*Tube Turns (Inc.) 89, 90
U. S. Electrical Motors (Inc.) 154
*Vogt, Henry, Machine Co. 140
Waldes Kohinoor (Inc.) 167
Walworth Co. 131
*Western Gear Works 83
*Westinghouse Elect. Corp. 24, 25, 41, 84, 85
*Wickes Boiler Co., Div. of Wickes Corp. 132, 133
Wiegand, Edwin L., Co. 63
*Wing, L. J., Mfg. Co. 152
Winsmith (Inc.) 47
Wolverine Tube Div., Calumet & Hecla Cons. Copper Co. 153
*Yarnall-Waring Co. 37
*Zallea Brothers 149

CONSULTING SERVICE . . . Page 166

Black & Veatch
Ehrco Die Casting Service
Electrical Testing Laboratories
Hathaway, C. M.
Jackson & Moreland
Kendall, George H.
Kuljian Corp.
Mast Development Co.
Myers & Addington
National Weld Testing Bureau
Nuclear Development Assoc.
Palmer, Delos M. & Assoc.
Polachek, Z. H.
Sanderson & Porter
Sargent & Lundy
Sirrine, J. E., Co.
Stanley Engineering Co.
Tour, Sam & Co.

Advertisers in previous 1952 issues but not in this issue

*Aldrich Pump Co.
All American Tool & Mfg. Co.
Allegheny Ludlum Steel Corp.
*American Felt Co.
American-Foot Pitt Spring Div. H. K. Porter Co.
American Pencil Co.
Anderson, V. D., Co.
Arkwright Finishing Co.
*Associated Spring Corp.
Aurora Pump Co.
*Bailey Meter Co.
Bell Telephone Laboratories
*Bin-Dicator Co.
Birmingham Committee of 100
Boston Gear Works
Briggs & Stratton Corp.
Brown & Sharpe Mfg. Co.
Brownell Co.
Burgess-Manning Co.
Bush Mfg. Co.
Carborundum Co.
Cassell, John R., Co.
*Chicago Bridge & Iron Co.
*Cleaver Brooks Co.
Coxhead, Ralph C., Corp.
Cuno Engineering Corp.
*DeLaval Steam Turbine Co.
Diamond Chain Co., (Inc.)
Diamond Power Specialty Co.
Drop Forging Association
Eagle Pencil Co.
Elliott Mfg. Co.
*Engineer Co.
*Erie City Iron Works
Faber-Castell, A. W., Pencil Co.
*Farrel-Birmingham Co.
Farval Corp.
*Flexitallic Gasket Co.
*Flexonics Corp.
*Foster Wheeler Corp.
Fulton Sylphon Div. Robertshaw-Fulton Controls Co.
*Garlock Packing Co.
*Gear Specialties, (Inc.)
General Radio Co.
*Golden-Anderson Valve Specialty Co.
*Goulds Pumps (Inc.)
Guardian Electric Mfg. Co.
Hagan Corp.
Hannifin Mfg. Co.
*Hoffman Combustion Engrg. Co.
*Homestead Valve Mfg. Co.
Hyatt Bearings Div. General Motors Corp.
*Illinois Gear & Machine Co.
*Iron Fireman Mfg. Co.
Johnson Reprint Corp.
Keuffel & Esser Co.
Key Co.
*Koppers Co.
Elex Precipitator
Lukens Steel Co.
Lunkenheimer Co.
McGraw-Hill Book Co.
Micrometrical Mfg. Co.
Morse Chain Co.
New Hampshire Ball Bearings, Inc.
Niagara Blower Co.
Nice Ball Bearing Co.
Northern Blower Co.
Nugent, Wm. W. & Co.
Oberdorfer Foundries (Inc.)
Open Steel Flooring Institute
Panoramic Radio Products (Inc.)
*Peabody Engineering Corp.
*Pennsylvania Pump & Compressor Co.
Philadelphia Gear Works
Philbrick, G. A., Researches
Pipe Fabrication Institute
Pittsburgh Piping & Equipment Co.
Plastic & Rubber Products Co.
*Posey Iron Works
Repro-Tempiets (Inc.)
*Republic Flow Meters Co.
Research Corp.
Ronald Press Co.
*Shafer Bearing Corp.
Smooth-On Mfg. Co.
*Spence Engineering Co.
Spraying Systems Co.
Sterling Electric Motors (Inc.)
Streeter-Amet Co.
Stuart, D. A., Oil Co. (Ltd.)
Sturtevant, P. A., Co.
Thomson Industries, Inc.
*Timken-Detroit Axle Co. TDA Brake Div.
Trabon Engineering Co.
United States Steel Co.
Vickers, Inc. Div. of Sperry Corp.
*Voss, J. H. H., Co.
Water Cooling Equipment Co.
Waterman Engineering Co.
Warren Webster & Co.
*Westinghouse Air Brake Co.
Wheeler, C. H., Mfg. Co.
Wiley, John & Sons
Williams Gauge Co.
Wisconsin Motor Corp.
Yoder Co.
Zurn, J. A., Mfg. Co.

here's why

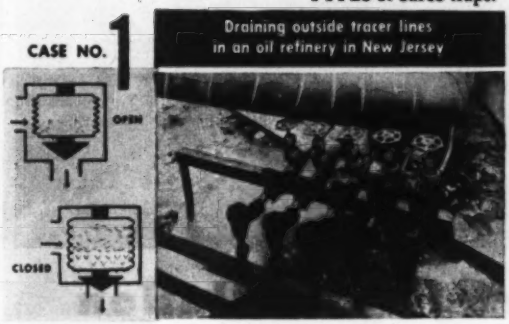
they selected 4 different types of steam traps for 4 different applications

CONDITIONS under which steam traps must operate vary widely, but there is for every service one type that gives maximum efficiency.

Sarco makes the 4 distinctly different TYPES of steam traps shown below. Therefore, Sarco can give you *impartial* advice on the best choice for your particular installation.

For each of the 4 jobs listed below, the users selected four different TYPES of Sarco traps.

CASE NO. 1 — Draining outside tracer lines in an oil refinery in New Jersey



Type of traps installed: Sarco No. 9 thermostatic traps.

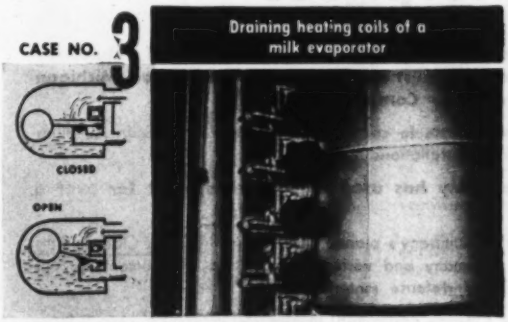
Why selected: Being thermostatic, they are steam misers. Can't freeze, being wide open when cold. Easy to maintain since only the bellows moves. Small, light and easy to install. Self-adjusting for different pressures.

CASE NO. 2 — Draining platens of compression plastic presses

Type of traps installed: 100 Sarco Inverted Bucket traps in service for 17 years.

Why selected: Press platens have small horizontal steam spaces; the intermittent blast discharge of these Sarco traps scours the heating surface. Built-in strainer cuts maintenance costs.

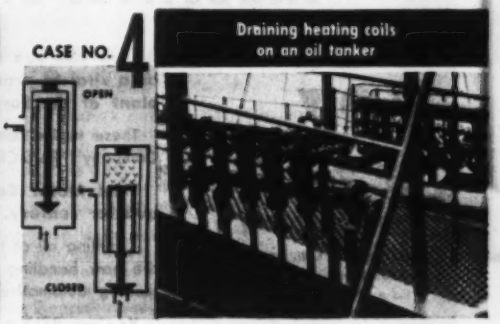
CASE NO. 3 — Draining heating coils of a milk evaporator



Type of trap installed: Sarco Float-Thermostatic Trap.

Why selected: Heating surfaces of the coils must be kept full of live steam—this Sarco trap discharges condensate as it collects. Can't airbind because the integral thermostatic vent gets rid of air, regardless of operating steam pressure and temperature. As shown in sketch 3 above, this vent does *not* depend upon the discharge of condensate.

CASE NO. 4 — Draining heating coils on an oil tanker



Type of traps installed: Sarco LIQUID EXPANSION traps No. 871.

Why selected: Traps on tankers are exposed to freezing weather and vibration. Sarco's No. 871 traps can't freeze; resist vibration, water-hammer, pressure pulsations and superheat. These traps discharge condensate at adjustable temperatures below 212°F., permitting use of some of the condensate's sensible heat.

● Write today for Bulletin No. 145-A: *Selecting the Right TYPE Steam Trap.* Sarco Company, Inc., Empire State Bldg., New York 1, N. Y. Represented in principal cities. Sarco Canada Ltd., Toronto 8, Ontario.

408

SARCO saves steam

improves product quality and output

Another Clarage Installation in One of America's 97* Largest Industrial Enterprises

***97**

OF AMERICA'S 100 LARGEST CORPORATIONS

are users of Clarage equipment . . . This wide acceptance denotes the high quality and reliable performance of Clarage products.

Above you see two of the twelve Clarage Improved Exhausters on a vital-to-production dust collecting job in the Monroe, Michigan plant of the Ford Motor Company.

These twelve fans operate in connection with twelve American Air Filter Company's Roto-Clone installations.

Ford Motor Company has used Clarage equipment for over a quarter century.

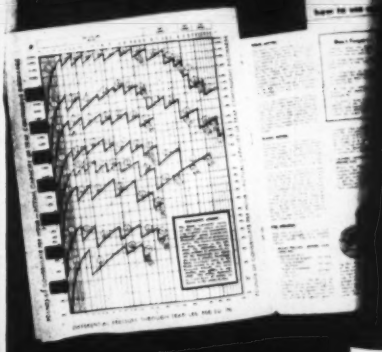
Counting all of this Company's plants, well over a thousand Clarage fans are now handling the many and varied air handling requirements of this leading automotive and defense materiel manufacturer.

You can RELY on Clarage equipment to give you economical service for a long time to come. CLARAGE FAN COMPANY, 609 Porter Street, Kalamazoo, Michigan.

You can Rely on...

CLARAGE

Headquarters for Air Handling and Conditioning Equipment



THE most carefully calculated installation of steam-heated processing equipment will fail to deliver full output if the steam traps do not have adequate condensate and air handling capacity. When this happens an important part of the capital investment in plant and equipment is wasted.

After you have figured the amount of steam that will be condensed, you need data on:

Condensate Capacity—not theoretical, not estimated, not cold water, but actual test findings with traps discharging condensate at steam temperature.

Trap Capacity Safety Factors, or ratio between continuous discharge capacity and actual amount of condensate to be handled. These may run from a low of 2 to 1 or as high as 8 to 1. Armstrong data tells you just what safety factor to use to obtain adequate air venting capacity and maximum heat transfer.

Armstrong trap data helps you get traps "big enough" for the job, but not too big; assures you maximum operating efficiency; eliminates corrections after installation. For traps and trapping assistance call your local Armstrong Representative, or write:

ARMSTRONG MACHINE WORKS
894 Maple Street, Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

New shell lathes cut, face, rough-turn, finish-turn—with help of TIMKEN® bearings

MODEL 2R shell lathes like this one are designed for production line manufacturing of artillery shells. They cut off the open end of the shell to proper length and face the base, as well as rough-turn and finish-turn the shell forging.

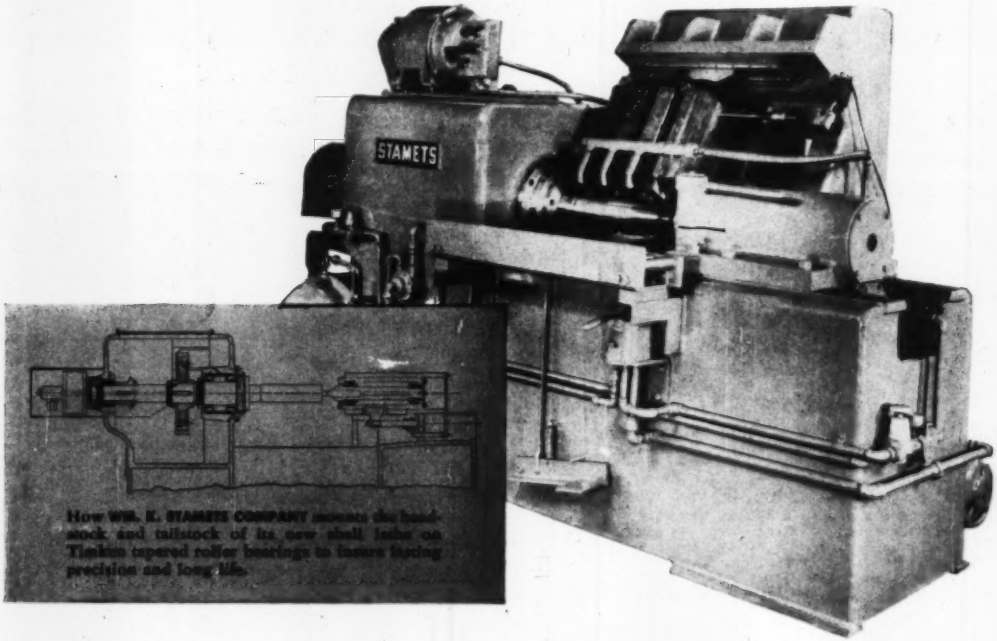
By mounting the lathe spindle on Timken® precision bearings, Wm. K. Stamets Company provides for lasting spindle accuracy. Timken bearings also are used on all other shafts to hold them in accurate alignment.

Tapered construction of Timken bearings enables them to take radial and thrust loads in any combination. Line contact between rollers and races provides extra load-carrying capacity. Spindle end-play and deflection are virtually eliminated. Chatter is prevented and tool set-ups stay set.

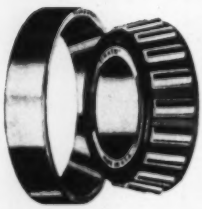
Timken bearings hold gear shafts in rigid, positive alignment. Accurate gear meshing is assured, gear wear minimized.

Timken bearings normally last the life of the machine in which they're used because they're engineered for the job, precision manufactured and made of Timken fine alloy steel. Make sure you have them in the machines you buy or build. Look for the trademark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



How WM. K. STAMETS COMPANY mounts the headstock and tailstock of its new shell lathe on Timken tapered roller bearings to insure lasting precision and long life.



TIMKEN
TRADE-MARK REG. U.S. PAT. OFF.
TAPERED ROLLER BEARINGS

FINISHED TO CLOSER TOLERANCES

Finishing to incredible smoothness accounts for much of the precise, smooth rolling performance of Timken bearings. This honing operation is typical of the amazingly accurate manufacturing methods at the Timken Company.

The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

NOT JUST A BALL ○ NOT JUST A ROLLER ⊃ THE TIMKEN TAPERED ROLLER ⊃ BEARING TAKES RADIAL ◫ AND THRUST →◫← LOADS OR ANY COMBINATION →✳←